Compressed Air Magazine

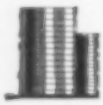
JANUARY 1944

TREASURY TUNNEL
SURFACE PLANT

Where zinc-lead-copper ore from the Black Bear Mine will be treated.

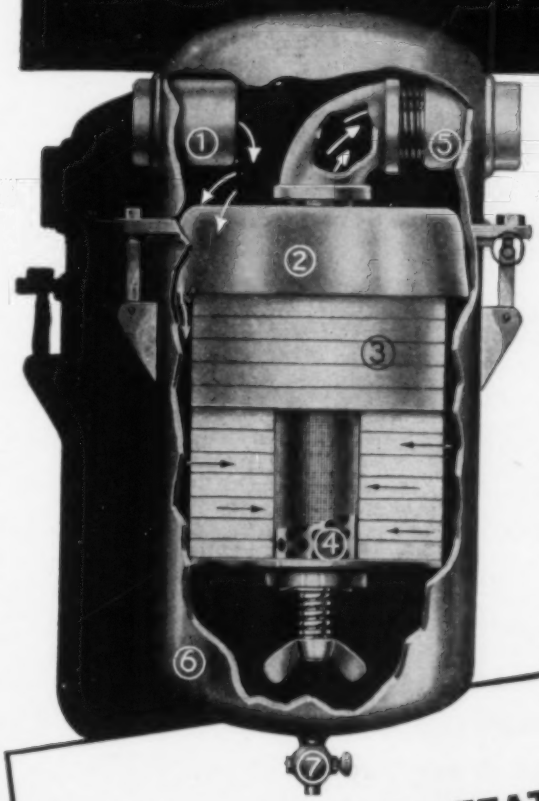
VOLUME 49 • NUMBER 1

NEW YORK • LONDON

A steam turbine needs a big frame to develop Elephant Power . But if you need only Horsepower, a COPPUS Steam Turbine saves money and metal . Six sizes from 150 Horsepower down to fractional. Each smaller size has smaller frame requires less metal and is priced less . Each is a COPPUS Blue Ribbon Turbine so you get top quality while saving money  and metal .

COPPUS TURBINES
Save Metal in Wartime — Will Save You Money in Peacetime
Like all Coppus "Blue Ribbon" Products (blowers, ventilators, gas burners, etc.), the small H.P. steam turbine is a precision-made product . . . controlled by Johansson size blocks . . . and every turbine is dynamometer-tested before shipment. 85% of all orders since 1937 have been repeat orders.
Write for Bulletin 135-9
COPPUS ENGINEERING CORPORATION
551 Park Avenue, Worcester, Mass.
Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEET'S.
COPPUS
BLUE RIBBON PRODUCTS
DESIGNED FOR YOUR INDUSTRY...ENGINEERED FOR YOU

HAZARD of Oil and Moisture in Automatic Controls NOW ELIMINATED



New Filter Delivers Dry Air Only

Amazing results are being reported by users of the Model AAPHS Pipe Line Filter as a final stage in the protection of delicate pneumatic control instruments.

Typical comment is that of a large producer of electric and steam power who says, "We tried several well-known methods of moisture and oil elimination without satisfactory results. Your Model AAPHS was finally installed in the air line and since then we have had no trouble whatever with oil or moisture in our automatic controls."

NEW 44-PAGE CATALOG: Describes entire line, including filters for building ventilation, pipe lines, engine, and compressor intakes. Your copy is ready.

DOLLINGER CORPORATION
(Formerly Staynew Filter Corp.)
7 CENTRE PARK, ROCHESTER 4, N. Y.

"Air Filter Headquarters"

STAYNEW PROTECTOMOTOR FILTERS

CONSTRUCTION FEATURES

(1) inlet; (2) baffle that distributes vapor-laden air to sides of container (6); (3) felt rings; (4) perforated liner; (5) outlet; (7) drain cock; (8) swing bolts for easy inspection (optional).

THICK FELT RINGS that remove every trace of oil or moisture.

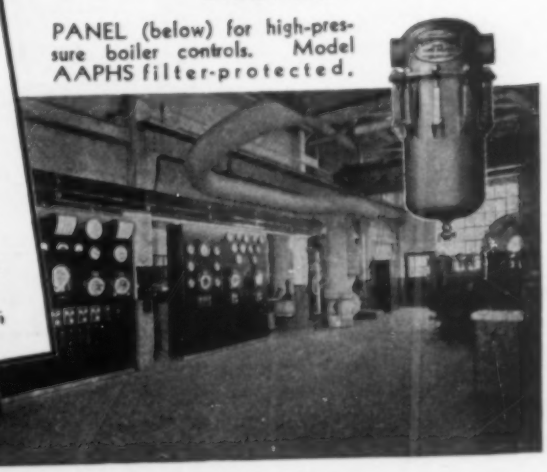
SPECIFICATIONS

Model	Standard Pipe Size	Capacity
AAPH-02 AAPHS-02	¼"	5 CFM
AAPH-01 AAPHS-01	¼"	7 CFM
AAPH-0 AAPHS-0	½"	10 CFM
AAPH-1 AA-PHS-1	¾"	20 CFM
AAPH-2 AAPHS-2	1"	30 CFM
AAPH-4 AAPHS-4	1½"	50 CFM
AAPH-5 AAPHS-5	2"	100 CFM

Letter S in code numbers indicates swing-bolt type which facilitates inspection.

Write for Bulletin "A"

PANEL (below) for high-pressure boiler controls. Model AAPHS filter-protected.



Compressed Air for automatic control

The increasing application of pneumatic control is recognition of its many advantages—reliability, simplicity, safety, and ease of maintenance. Automatic pneumatic control is one of the cornerstones of continuous processes, and without it many process industries could not operate.

Here is another striking example of the utility of compressed air power. It may suggest to you a means of solving many of your problems by applying air—the power medium for countless jobs which cannot be done as well, if at all, by any other method.

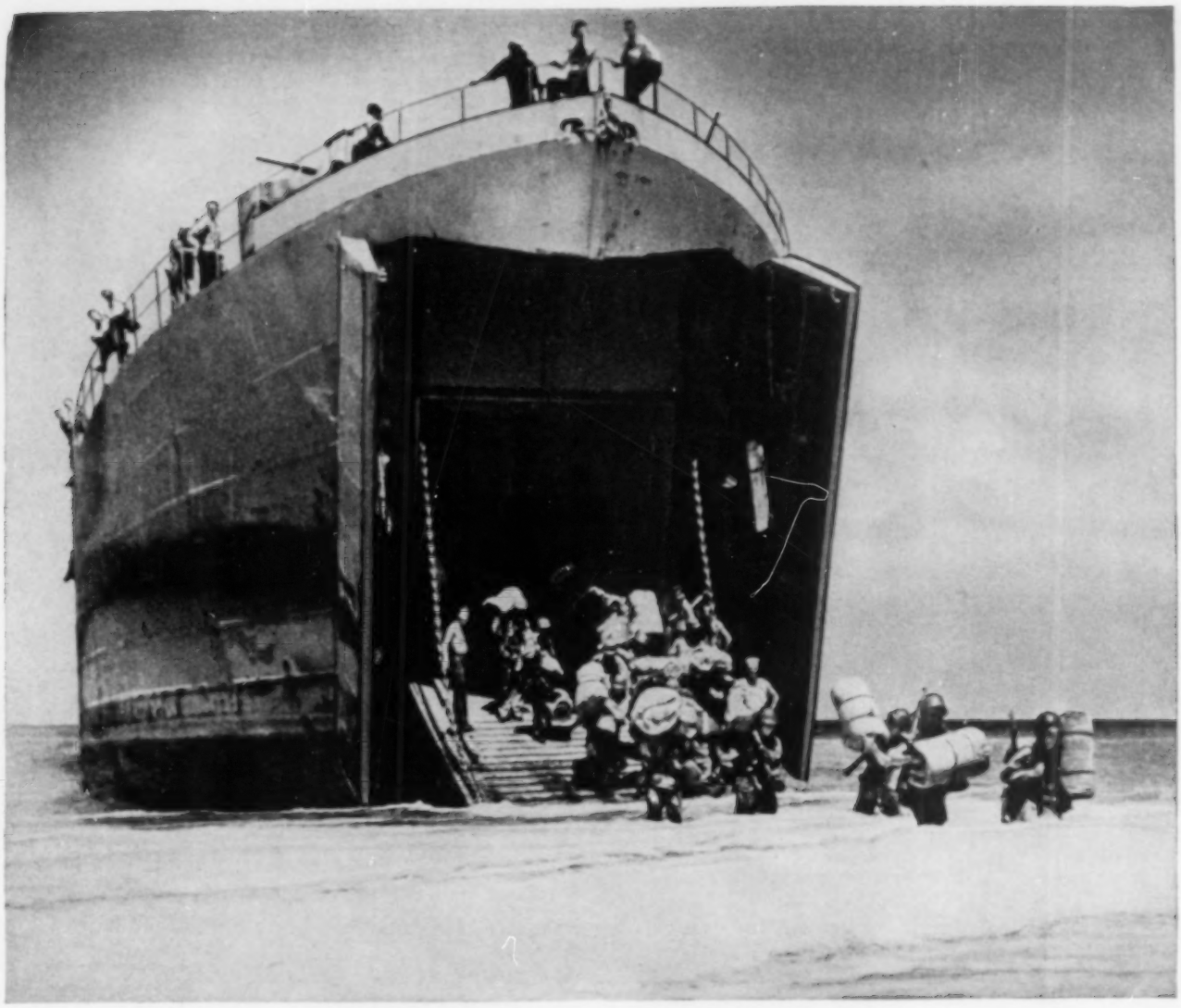
Ingersoll-Rand has pioneered compressed air systems since 1871, always supporting and developing new and time-saving applications. Our engineers will be glad to cooperate with you. Ingersoll-Rand Co., 11 Broadway, New York, N.Y.

BUY WAR BONDS AND STAMPS

Ingersoll-Rand

1-335

COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS



TROJAN SEA HORSE

UNITED STATES NAVY LST's "dock" where there are no docks. They just push up to the shore and unload their troops and tanks . . . over ramps raised and lowered with the aid of compressed air.

Air compressors, afloat or ashore, in whatever type service, are kept at peak efficiency . . . lubricated with Texaco.

Texaco Alcaid, Algol and *Ursa Oils* assure wide-opening, tight-closing valves, free piston rings, open ports, clean air lines, maximum service life between overhauls, fewer repairs and replacements.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States.

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ *More revenue airline miles in the U. S. are flown with Texaco than with any other brand.*

★ *More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.*

★ *More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

★ *More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.*

★ *More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.*

TEXACO

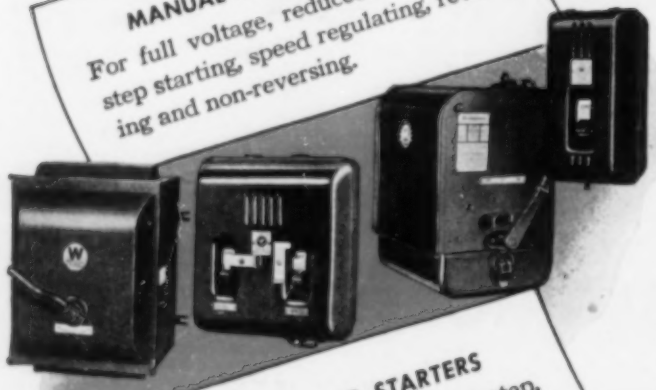
TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

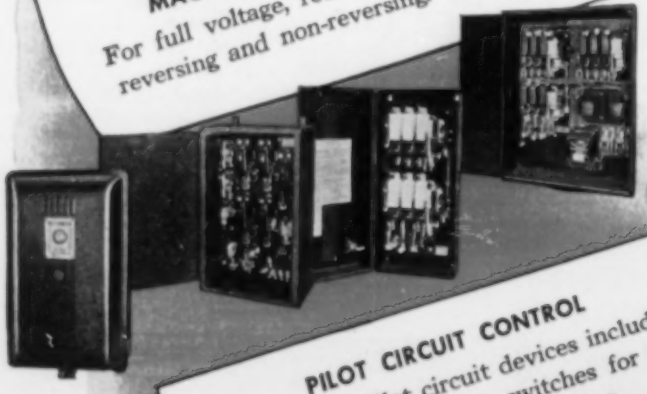
TUNE IN FRED ALLEN EVERY SUNDAY NIGHT – CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

and Motor Control shall be designed to:
1. PROVIDE THE GREATEST RELIABILITY FOR TODAY'S HIGH SPEED WAR PRODUCTION
that's Westinghouse

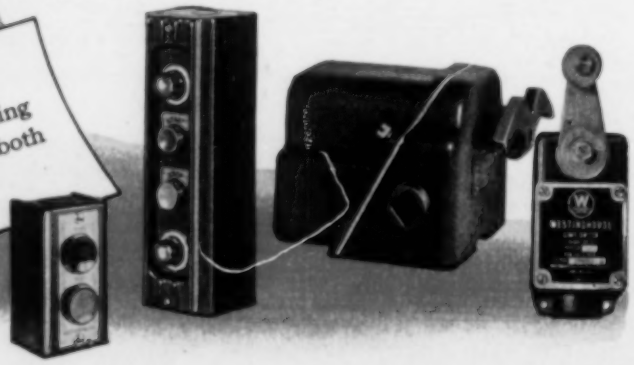
MANUAL MOTOR CONTROL
For full voltage, reduced voltage, or step starting, speed regulating, reversing and non-reversing.



MAGNETIC MOTOR STARTERS
For full voltage, reduced voltage, step, reversing and non-reversing.



PILOT CIRCUIT CONTROL
All types of Pilot circuit devices including push buttons and limit switches for both standard and heavy-duty service.



Design features like the Westinghouse "De-ion" principle of arc extinction are certainly a common-sense "must". And today's production goals need the kind of protection that the Bi-metal overload relay can give. The Westinghouse line of a-c and d-c motor controls is complete for motor types that meet requirements of a wide variety of applications.

So when you need motor controls — write "Westinghouse" in the specifications. Then get your Westinghouse representative on the phone. He'll help you all the way from application to installation. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

J-21270

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

MOTORS AND CONTROLS

NEW TRAINING FILM FOR MAINTENANCE WORKERS

TEACHES PROPER HANDLING OF VALVES, FITTINGS AND PIPE

TRAINING new workers in the fundamentals of piping maintenance becomes an easier task with this "Piping Pointers" sound film. It quickly familiarizes trainees with various types of valves and fittings and explains how to choose the most practical equipment for each use. It shows what to do when valves leak—how to handle many other maintenance problems—how to conserve time and critical materials. One complete section is devoted to the "*Language of Piping.*"

Manual Makes This Film More Valuable

Making this film doubly effective is the new 32-page Crane "Piping Pointers" manual which takes up in greater detail each subject covered in the film. This is the most complete manual of its kind ever compiled by Crane—it's full of valuable "know-how" data for every piping man. And all the information given in both film and manual is fully dependable because it's based on Crane's own 88-year experience as the world's leading maker of valves and fittings.

Act Now to See This Film in Your Plant. Requests for the "Piping Pointers" film are coming in fast. Assure a convenient early showing in your plant. Get in touch soon with your local Crane Branch that will arrange for use of the film and provide a supply of manuals. If you prefer, use the coupon below and we'll have the Crane Branch contact you.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Illinois.

FILL IN AND MAIL TODAY

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Attention: Advertising Dept.

Put us down for the earliest possible showing of "Piping Pointers." Have the nearest Crane Branch get in touch with me.

Name.....

Title.....

Company.....

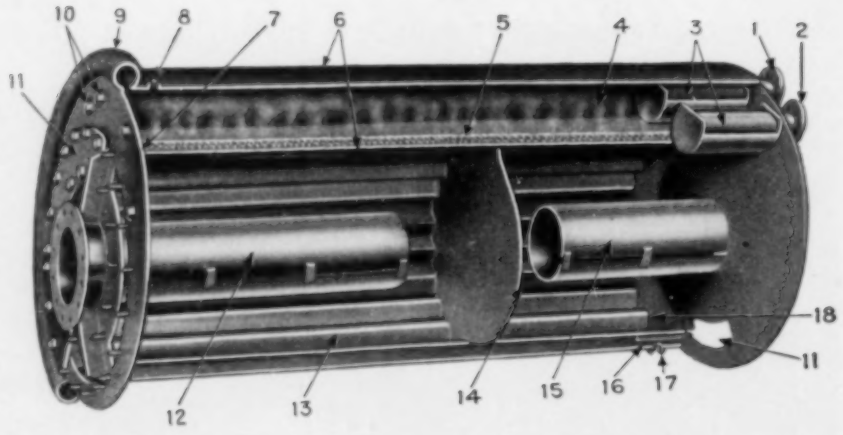
Address.....

City.....*State*.....

CRANE VALVES

MAXIM HEAT RECOVERY SILENCERS *save fuel!*

Extra steam or hot water for industrial processing operations or for heating purposes can be readily obtained by utilizing waste exhaust heat with Maxim Heat Recovery Silencers. The fuel saving is obvious, as the heat source is simply the engine exhaust gases which normally are wasted.



1—Steam Outlet
2—Safety Valve Connection
3—Dry Pipes
4—Steam Space
5—Water Line
6—Shells—Cylindrical to withstand steam pressure and pulsating gas flow
7—Inlet Head
8—Pressure Gauge Connection
9—Expansion Joint—permits dry operation
10—Water Gauge Connections
11—Cleanouts—provide easy access for cleaning heating surface
12—Inlet Bleeder Tube
13—Extended Heating Surface—forming conduits for leading exhaust gases from one attenuating chamber to the other
14—Insulated Intermediate Head
15—Outlet Bleeder Tube
16—Feed Water Deflector Plate
17—Feed Water Connection
18—Exhaust Gas Outlet from side conduits formed by extended heating surfaces

HIGH HEAT RECOVERY . . . Maxim Heat Recovery Silencers achieve highly efficient heat transfer through high mass gas velocities and the use of extended heating surfaces, a type of construction that is extremely dependable and requires minimum attention.

HIGH DEGREE OF SILENCING . . . These units embody the Maxim principle of silencing and can be had with or without the spark arresting feature. Based on silencing principles pioneered by Maxim and developed through years of practical field experience, they afford highly effective silencing of exhaust with minimum of back pressure.

COMPACTNESS AND LIGHT WEIGHT . . . Maxim Heat Recovery Silencers are extremely compact and can in most cases be installed in the space normally used for a regular silencer unit.

AUTOMATIC CONTROL . . . In the boiler, the steaming rate is controlled by varying the amount of water in contact with the heating surface; low water, less effective heating surface; high level, more effective. The control is accomplished automatically by two steam pressure regulated valves, one in the feed line, one in the return line, working in conjunction. (See bulletin WH-100)

ABILITY TO RUN DRY . . . Because of the type of construction, with extended heating surfaces, not tubes, it is possible to run these units dry without any danger of damage.

QUICK RETURN ON INVESTMENT . . . Maxim Heat Recovery Silencers produce usable steam or hot water from a present source of heat. Hence steam or hot water for processing operations or for heating the plant is available with no extra fuel cost. This obvious saving represents a quick and often substantial return on your investment.

AVAILABILITY . . . At this time the Maxim Silencer Company's production is devoted to war needs. It is our feeling, however, that this Waste Heat story has sufficient post-war importance to make your investigation worthwhile now, whether or not your present priority status allows immediate purchase of the equipment.

This northern Minnesota power plant is heated entirely through use of Maxim Heat Recovery Silencers.

SEND FOR DESCRIPTIVE BULLETINS

Maxim Waste Heat Bulletins WH-100, WH-102 and WH-103 will be sent to you on request. Simply send your request to The Maxim Silencer Company at the address below.

THE MAXIM SILENCER CO.
85 Homestead Ave., Hartford, Conn.

MAXIM

from News Bulletin of a mining journal . . .

MICHIGAN - A drifting record for the Michigan Copper district has been set in the Iriquois No. 1 shaft being sunk by Calumet & Hecla. A total of 798 feet in 25 days, an average of 31.9 ft. per day. The maximum advance in any 24 hr. period was 41 ft.

Another drifting record with the aid of EIMCO LOADERS

Wherever tunnel or drifting records are being established—wherever new records are being made—there, you will find the Eimco Loader playing a major part in getting the muck loaded and speeding the cleanup cycle.

Eimco's patented mucking action is still the choice of the champions for dependability, speed, ease of operation and efficiency in loading.

We ask nothing more than an opportunity for the Eimco Loader to sell itself. Write today!

EIMCO

THE EIMCO CORPORATION, SALT LAKE CITY 8, UTAH

NEW YORK 120 BROADWAY — SACRAMENTO, 1217 7TH ST.

CHICAGO 111 W. WASHINGTON ST — EL PASO, MILLS BUILDING

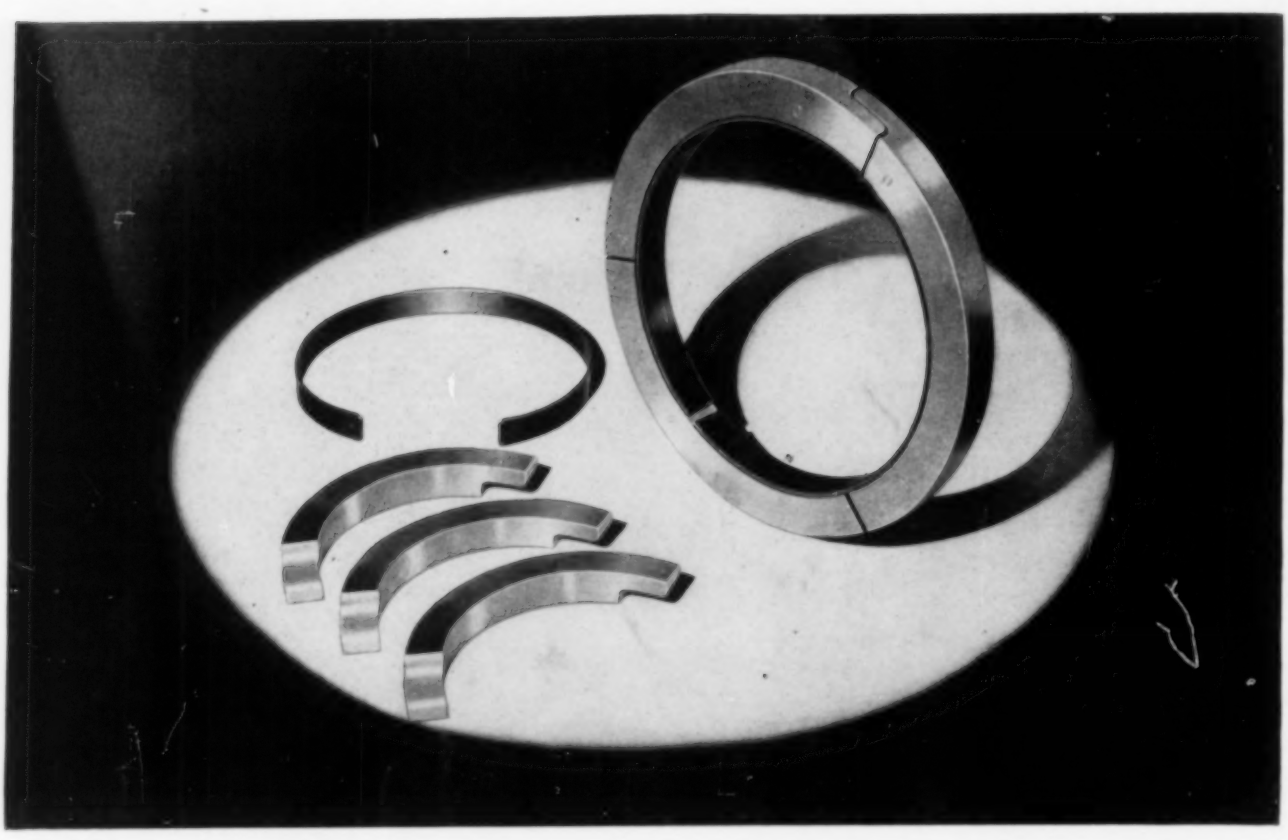
HERCULES
TAMPTITE
TAMPTITE
Speeds work - saves time
A Tamptite cartridge is easily, quickly inserted into the bore hole in the usual manner. No wasted man-hours slitting cartridges. No loose, spilled powder to worry about. Then—
TAMPTITE
Packs snugly
gives better breakage
You tamp a Tamptite cartridge in the usual manner. It packs evenly, snugly—leaves little air space—concentrates the charge for good breakage, faster mucking.

INCREASED TONNAGE, together with savings in valuable man-hours, can be gained by using your regular Hercules explosives in the new Tamptite* cartridges. Tamptite shells are convenient, easy to use. They eliminate the mess and trouble of slitting cartridges. They compress in the bore hole with a compactness that assures good breakage. And, the better breakage, of course, means easier, faster mucking. In fact, Tamptite speeds up your entire mining cycle. On your next order, specify Hercules in Tamptite cartridges.

HERCULES EXPLOSIVES

HERCULES POWDER COMPANY
INCORPORATED

*Reg. U. S. Pat. Off. A-99



THE *UNIVERSAL* COMPRESSOR RING

FOR PISTONS OF *INDUSTRIAL* SIZE COMPRESSORS

Available in — Cook's Graphitic Iron, Type 104 — Cookmet, Type 104C — Laminated Bakelite, Type 104B — Many other special materials

These COOK'S Rings are truly "universal" because the selection of materials in which they are available meets the requirements no matter what the nature of the gas may be. You can get them, for instance, in the tough, enduring COOK'S Graphitic Iron, with or without "tinized" surface treatment—or in COOKMET, a plastic bronze that comes in many mixtures—or in Laminated Bakelite—or in a variety of other materials—all fully proved in actual service.

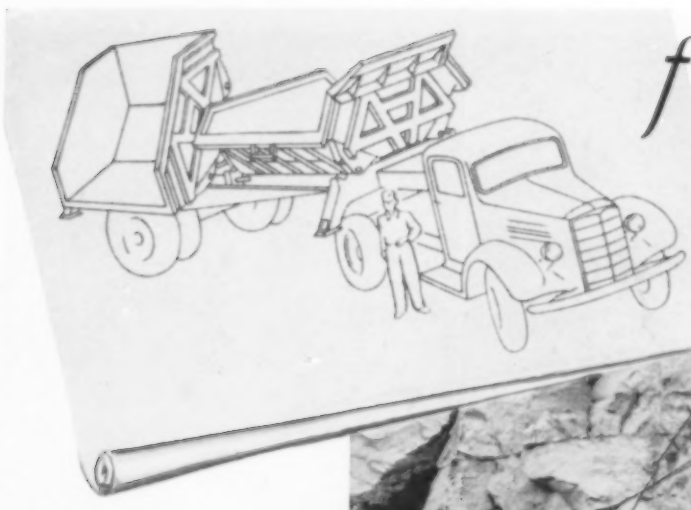
These COOK'S Rings are universal also because, once the piston is grooved to take this style of ring, you can change to a more desirable ring material if the gas changes or the cycle is not just as originally contemplated. In short, COOK'S Universal Compressor Rings make it always possible to use rings of the correct material for the conditions, with minimum effort and expense.

Many leading Compressor Manufacturers use Cook's Rings in the original assembly. Others will supply them on request. To make sure your new compressor is fitted with these Universal Piston Rings specify them by name on your compressor order. For existing equipment write us direct or contact our nearest office.

C. LEE COOK MANUFACTURING CO., Incorporated, Louisville, Kentucky. Branch Offices and Representatives—Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, Montreal, New Orleans, New York, Portland, Ore., San Francisco, Seattle, Tulsa.

Sealing Pressures Since 1888

COOK'S GRAPHITIC IRON PISTON RINGS



from Blueprint to Quarry

Chief Engineer
OF WESTON & BROOKER
Quarries at
Cayce, South Carolina
and Camak, Georgia.

Another EASTON *Success!*

The double-bodied semi-trailers now in operation at Weston & Brooker Company serve to illustrate the versatility of EASTON engineers (who specialize in quarry haulage problems).

Luther J. Burriss, Chief Engineer at Weston & Brooker, sums up the performance record as follows: "With our modern tractors and the dual body semi-trailers we are hauling nearly twice our previous tonnage in the same time cycle with no increase in cost of fuel and oil and with the same labor that we formerly required with our back mounted units previously used."

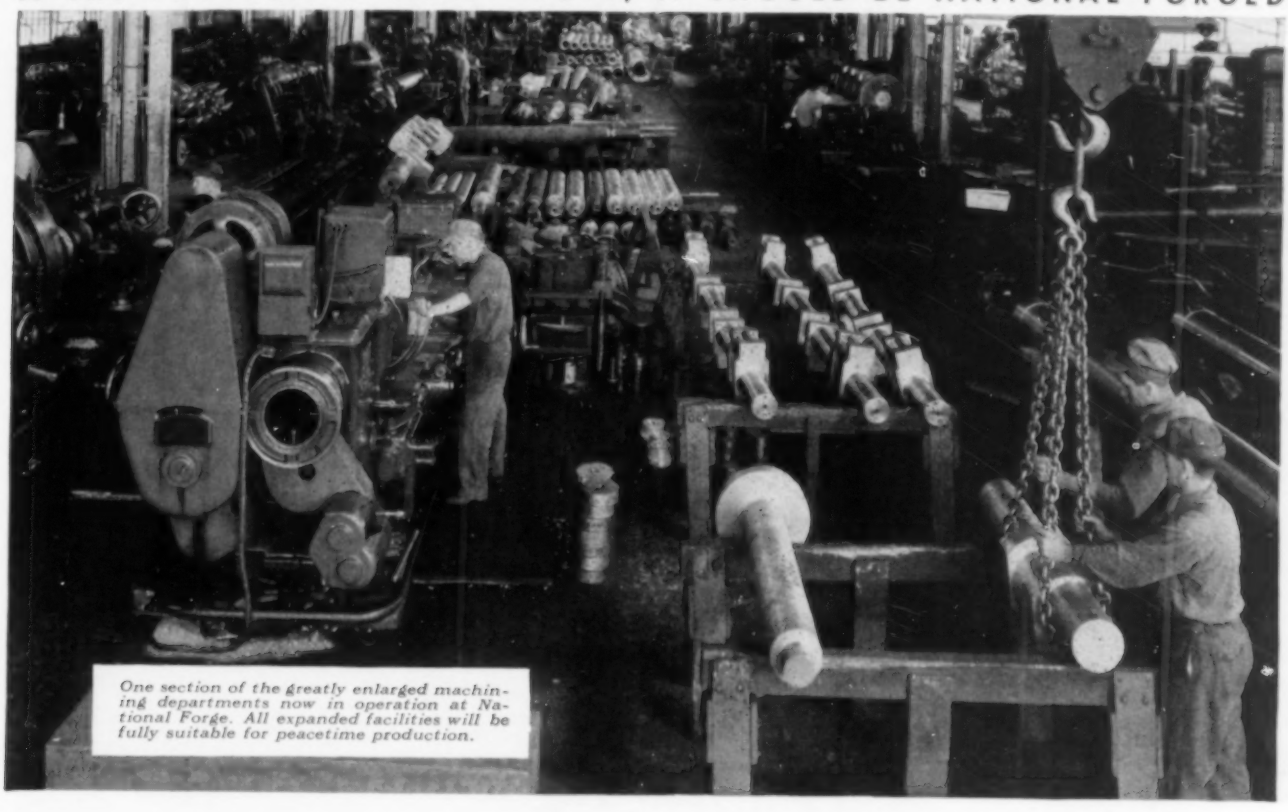
Problem: An EASTON survey showed that a 17-ton payload would prove most economical, but such a load entering the small hopper in one discharge would have choked the crusher.

Answer: Double-bodied semi-trailers—blueprinted by EASTON several years ago. A unique solution for just such a set of conditions. Write to: Engineering Counsel, Easton Car & Construction Company, Easton, Pa.

EASTON
INDUSTRIAL CARS
TRUCK BODIES · TRAILERS
ELECTRIC LIFT TRUCKS

B-1009

IF THE FORGING IS HEAVY DUTY, IT SHOULD BE NATIONAL FORGED



One section of the greatly enlarged machining departments now in operation at National Forge. All expanded facilities will be fully suitable for peacetime production.

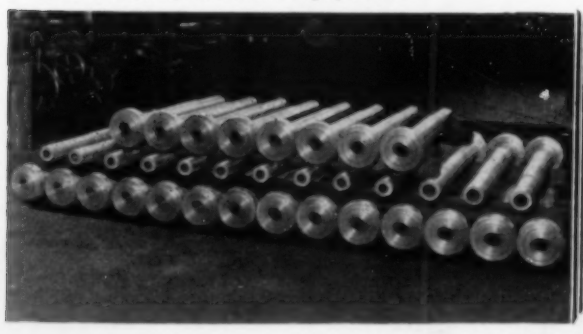
WHY FORGINGS MUST BE *Precision Products*

EVERY heavy duty steel forging has a big and often brutal job to do. And it is often work that calls for precision operation. Consequently it must be accurately machined to precisely fit equipment for which it is designed. National Forge has long held a high standing for precision craftsmanship.

"Precision checked by precision" is the constant watchword at National Forge, where every machined forging must pass the most exacting checks and re-checks before it is okay for delivery. Equipped with machine tools of great capacity and accuracy, manned by master mechanics trained in National Forge quality standards, the National Forge organization is as outstanding for its machining accomplishments as it is for the skill of its forgesmithing and the cleanliness of its steel making.

Steel forging has made great progress during the war emergency and the steel forgings of the future will be ordered with full regard for the achievements of makers in wartime production. Considering the greater facilities and experience National Forge will be able to place at your command, it will be even more true that steel forgings with heavy duty work to do should be National Forged.

Hollow Bored Machine Spindles. National Forge has long held a preferred position for the accuracy of its internal boring and machining operations.



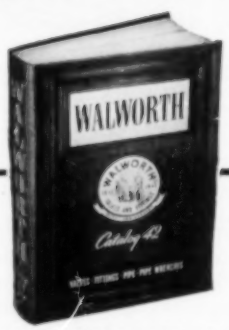
NATIONAL FORGE & ORDNANCE CO.
IRVINE, WARREN COUNTY, PENNA.
"WE MAKE OUR OWN STEEL"
For Excellence E *in Production*

FIT THE VALVE TO THE SERVICE

WHERE THROTTLING IS NOT REQUIRED
Walworth No. 95 Re-New-Disc Bronze Globe Valve saves time and trouble in changing discs because of the lock-on, slip-off disc holder originated by Walworth. It's an ideal globe valve for use where throttling is not required. General purpose discs are regularly furnished, and special discs are available for unusual services.
WHERE THROTTLING IS REQUIRED
Walworth No. 245P, with its hard plug type disc and seat, is designed for throttling service. It resists "wire drawing" and lasts longer. Like the No. 95, extra strength in the body-to-bonnet connection is obtained by the union bonnet design.
MADE IN U.S.A. WALWORTH RE-NEW-DISC
MADE IN U.S.A. WALWORTH

Walworth No. 95 and Walworth No. 245P are two excellent valves for general service. They are well designed, made to precision standards, and proved in the services for which they are recommended. They are engineered for specific purposes . . . No. 95 for general service, No. 245P for throttling service . . . and each has its distinctive features of design and construction. *Fit the valve to the service.*

BOSTON AND KEWANEE PLANTS



To help you "fit the valve to the service," you'll find pertinent information on Walworth's *complete line* of valves, fittings, pipe, and pipe wrenches in the new Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy.

WALWORTH

VALVES FITTINGS and TOOLS
Backed by 101 Years' Service

WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

GIVE THEM THE BEST

Give Them Air Tools

The cost of power for any portable tool is small when compared with the operator's wages. Therefore, consider aiding your operators by giving them smaller, lighter and more powerful AIR tools which will enable them to do an easier, quicker and better job.

Flexibility of *AIR* Power . . . More types of work can be done with AIR tools than with any other type of portable tools. Their wide range includes not only rotary applications (such as drilling, reaming, grinding, nut running, etc.), but also such percussive applications as riveting, chipping, ramming, tamping, etc.

Flexibility of Control . . . AIR-powered tools can be started and stopped instantly—this speeds up repetitive operations. Torque and speed can be varied throughout the capacity range—full power can be obtained immediately. This control permits the operator to fit the tool exactly to his work from moment to moment.

Flexibility of Application . . . Flexible control automatically gives the AIR tool wide application. It can be used on a great variety of materials—it will handle numerous types of jobs in any shop.

Choose from the complete line of I-R AIR tools . . . and increase your production.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

8-352

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

DISC WHEELS...

Can Speed Many Jobs in the Cleaning Room

Surface grinding with Norton Discs is the quickest and easiest way to do many snagging jobs. These discs not only remove metal quickly but leave a surface that often needs little or no further machining.

Norton Discs are available in all the sizes and types of mountings necessary for foundry grinding—in vitrified, resinoid, shellac and silicate bonds—in Alundum abrasive for steel and malleable iron castings—in Crystolon abrasive for gray iron, brass, bronze and aluminum castings.

A Norton booklet "Disc Grinding—A Production Operation" gives the full story. Just write for Form 1141-CA—no obligation.

NORTON COMPANY, WORCESTER 6, MASS.

W-947

NORTON ABRASIVES

ON THE COVER

OUR cover picture was taken from a point on the side of the mountain under which the Treasury Tunnel is being driven to tap reserves of ore in a mine nearly 2 miles away and lying 1,000 feet higher. In the foreground is the flotation mill that is being enlarged to handle 500 tons a day, and beyond it are the boarding house and bunkhouse. The square structure at the far edge of the lake is the office. The compressor plant, change house, and shops are in the center, and a part of the dump is in the left-center. In the distance is the valley down which the road runs to Ouray. Evidence of former mining activity is visible on the right hillside. Nearby was once the town of Red Mountain, which grew large enough to have its own water-distribution system.

IN THIS ISSUE

MANY of the ships that have gone down during the war have already been salvaged and, in some cases, returned to service. Many more remain to be raised, and years will be required after the war is over to complete the task. Our Navy runs a school for divers to train enlisted men for this service. It is hardly a cream-puff school. Our leading article tells what the students do eight hours a day for fourteen weeks.

FOR many years mining men battled austere Nature in order to extract ore from the Black Bear Mine. Perched precariously on the high rim of a glacial cirque above Telluride, Colo., the mine continually flirted with the threat of disaster in the form of snowslides. In 1926 an avalanche swept down the steep slope and the Black Bear surface plant was badly damaged. Since then the property has been idle. Now hard-rock men are driving a tunnel under the workings from a lower level to tap the stopes of zinc ore needed in the war effort. Our second article gives the details.

DUST is one of machinery's greatest enemies. Since ordinary air contains much dust, such machines as air compressors, blowers, and internal-combustion engines are especially susceptible and apt to be damaged unless suitable steps are taken to cleanse the air before it enters them. Effective filters are fortunately obtainable for this purpose. Dry-type filters are discussed in this issue by J. S. Zahniser, vice-president, Dollinger Corporation.

A SHORT article deals with the laying of continuous, welded rails the length of the 6-mile Moffat Tunnel in Colorado. Another one tells how discarded silk and nylon hosiery is converted into war materials.

Compressed Air Magazine

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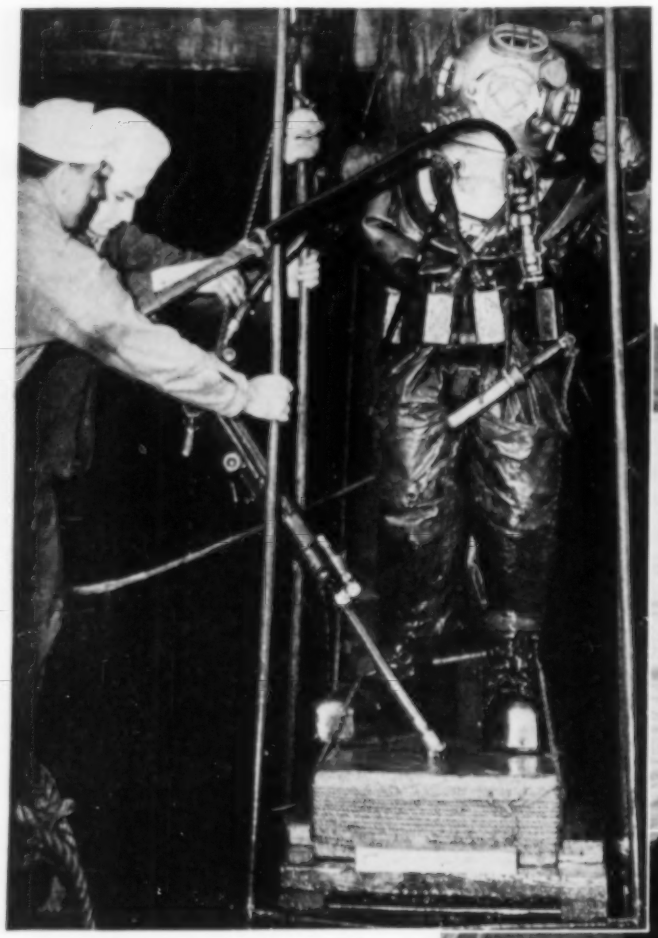
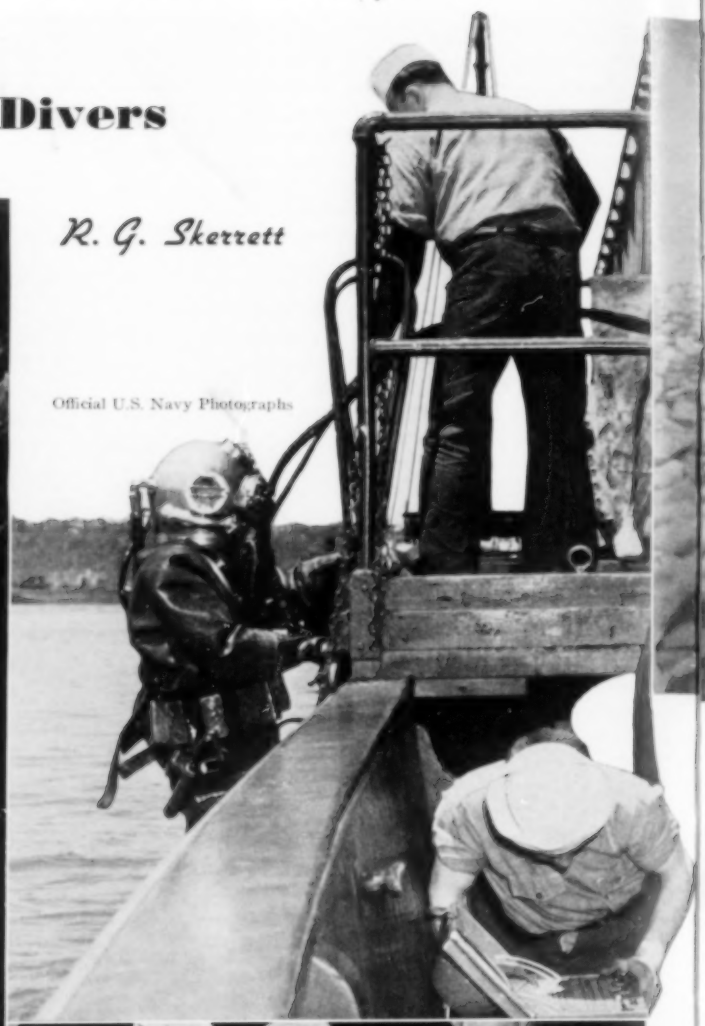
How the Navy Trains Salvage Divers

R. G. Skerrett

Official U.S. Navy Photographs





DIVERS IN THE MAKING

The diver pictured above has just been raised from the water on a diving stage that is elevated and lowered by a compressed-air hoist. His job while submerged was to drill holes in a concrete block with the JB-5 Jackhamer shown in slanting position. The sailors at the right are being taught how to apply a hinged "Tooker Patch" to seal a hole in a ship underwater. After the students have been trained in water 40 feet deep at Pier 88 in New York, they are taken up the Hudson River to practice their lessons at depths up to 150 feet. One of them is seen going over the side of a boat (top-center). Because salvage work goes on regardless of weather conditions, the diving school runs on the same basis. On the next page a diver is shown being hauled aboard a float through ice-laden water. At his left is brought up for inspection the job that he executed while submerged. Many operations are done in a diving tank having glazed sides that permit instructors to watch the work. The student at the extreme right was photographed through the glass while laying a welding bead on steel plate. Sailors who successfully complete the course wear the insignia pictured.

IN WAGING modern amphibious warfare, the U. S. Navy is not only using its historic "web-footed" fighting men—the marines—but also valiant construction workers called Seabees and a body of specially fitted bluejackets designated as Salvage Divers. These organizations are, in their several ways, helping us to outfight and to outwit our enemies. The rating of Salvage Diver is an innovation born of the circumstances of present-day armed strife; and the man entitled to wear the badge of that rating on his sleeve is rightly proud of his distinction. It stamps him as a member of the Navy's enlisted personnel who has trained for hard and often hazardous duty that has already proved of value in many places at home and in foreign waters.

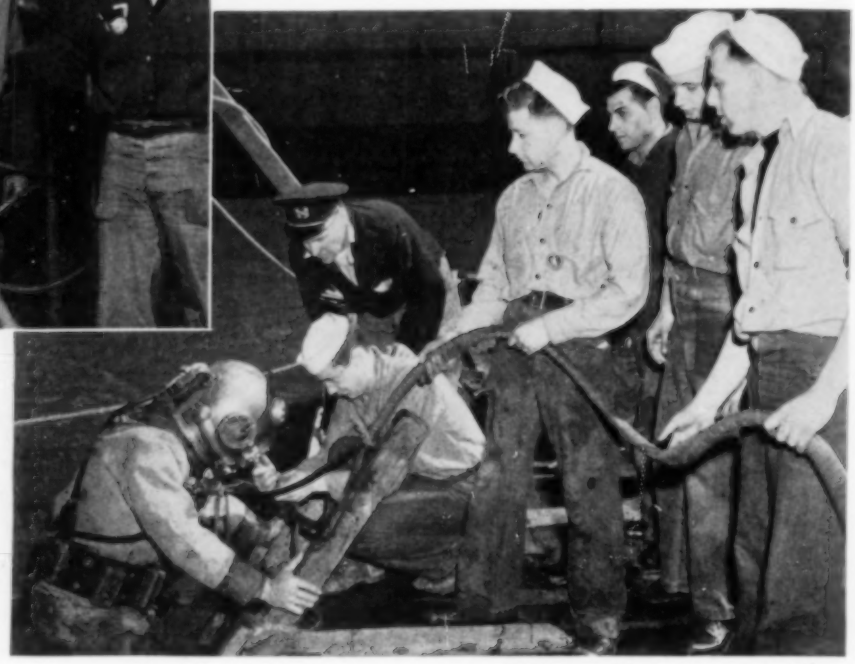
The diver is not a novelty in our Navy, for the service has been training men for years for deep-water operations. Many have been notably conspicuous in perilous undertakings associated with the recovery of some of our sunken submarines, and even with the rescue of the men carried down in them. While this work may properly be classed as underwater salvage, still there is a difference in the service and the tasks that may be assigned the bluejackets who have won the rating of Salvage Divers.

The need of salvage divers was made evident following the Japanese air attack on Pearl Harbor two years ago. That raid, as most of us now know, placed the Pacific Fleet in a perilous position by sinking and otherwise damaging a large number of the ships that happened to be there at the time. It was extremely important that as many as possible of those vessels be salvaged and repaired without delay, and that meant the services of many more divers than were available in the Hawaiian Islands. The shortage was offset by flying in naval and civilian divers from our West Coast; but, as the work of reclamation went on, the authorities recognized that the salvage of ships stricken in conflict called for divers of a newer order—men trained for the purpose and expert in using the mechanical equipment that modern engineering has devised for operations both underwater and aboveboard on wrecks that may be submerged, held in the grip of a reef or, beached.

About two months after the Japanese struck at Pearl Harbor, the French liner *Normandie*, taken over by the Navy for conversion into a transport and newly named the *Lafayette*, caught fire, capsized, and sank in her slip adjacent to Pier 88 in the Port of New York. When the Navy Department decided to refloat that immense ship, it was recognized that success would hinge upon the advance work that would have to be done inside and outside of that awkwardly situated vessel. The unparalleled scope of those preparations, and the thoroughness with which they had to be carried out, made it clear that the job would require an exceptionally large number of divers, as well as men of technical understanding that could go underwater and supervise the activities of the divers. Neither was obtainable from the Navy's personnel or from civil life in sufficient number to supplement the limited force of commercial divers upon whom rested the major part of the burden.

With the approval of the Bureau of Ships and the Bureau of Naval Personnel, Commander William A. Sullivan, U.S.N. (since promoted to the grade of commodore), who is a recognized specialist in ship salvage and was in charge of operations on the *Lafayette*, called into being on Pier 88 a school for the training of young naval officers and bluejackets for work on that vessel. At the start, fourteen officers—but lately graduated in engineering—were assigned to duty on the pier. There they first received a course in naval architecture to fit them to act as junior foremen on the ex-liner; next, they qualified in diving; and, finally, they were given instruction in salvage engineering. Then 75 enlisted artificers of the Navy—all volunteers for the work—were detailed to the special diving school.

The *Lafayette* proved to be an extremely useful practice ground, and from that beginning in May, 1942, the enrollment at the Navy Salvage School, as it is now known, gathered headway and importance. It is well organized and equipped, and each instructor is fully qualified to deal with his particular field. The aim of the curriculum is to learn by doing—to make divers that will be able to do underwater, perhaps in utter darkness, what they are taught to do above water. The novices must become familiar with marine-salvage apparatus and equipment and know how to get the best out of tools when working in close quarters where the left instead of the



FIRST TIME UNDER

Rookie salvage divers must learn how to dress a diver (left) as well as how to work when clad in the cumbersome trappings. Early in the course, each student is given a foretaste of what is to come (below) by being submerged for ten minutes in 40 feet of water. Those who lose their zest for diving after this test are reclassified and assigned to other duties. Approximately two-thirds of those who volunteer for the course go through with it.

right hand may have to be used. Each given stint must be performed not only with satisfaction but with resourcefulness and self-reliance; indeed, the salvage diver has to be truly a handy man, alert and cautious, amphibious and ambidextrous.

Pier 88 is under the supervision of Lieut. Commander C. F. Chandler, U.S.N.R., acting as resident salvage officer. He saw service in the Navy as an enlisted man during World War I, afterwards became a successful engineer in civil life, and returned to the Navy as a reserve officer when the present war became imminent. The Salvage School is under the direction of Lieut. William Mahan, U.S.N., executive officer, who did his turn at Pearl Harbor and is eminently qualified for his detail. His right-hand aide is Lieut. (JG) Edward M. McLagan, U.S.N., who performed perilous work as a diver during salvage operations in 1925-26 on the U. S. Submarine *S-51* which was recovered from a depth of 132 feet in the storm-swept waters off Block Island, R. I.

According to a release issued by the Public Relations Office not long ago, the average number of volunteer bluejackets studying at the Navy Salvage School at any given time is 430, and of this number about 275 complete the course. The more skillful are graduated as "Salvage Divers"; the others as "Divers Second Class." Artificers of the Navy who have already earned special ratings but who take the training wear their regular badges and the insignia won at the school. The youngsters new to the Navy who go there and earn either of the ratings given may obtain additional ratings if they qualify for them in service

The school is an interesting and busy place, and many of the following details about its activities have been furnished by Lieutenant Mahan. New students arrive about every two weeks. Some of them are from the fighting fleet, and considerable numbers are transferred from the Navy Diesel School and from the Machinist Mate School. A percentage comes from "boot training"—the present-day recruits. To aid the staff in directing the course each applicant should follow, the latter has to fill out a questionnaire—answer 23 questions such as: What experience, if any, has he had with pneumatic tools, gas burning, electric welding, gas engines, as a mechanic, or as a rigger? Is he a qualified swimmer? Is he familiar with the use of rescue-breathing apparatus and the submarine escape lung? Has he ever done any hard work? Has he acquired the habit of drinking to excess? He is warned that diving is a hazardous calling and is required to state specifically that he wishes to volunteer for the work.

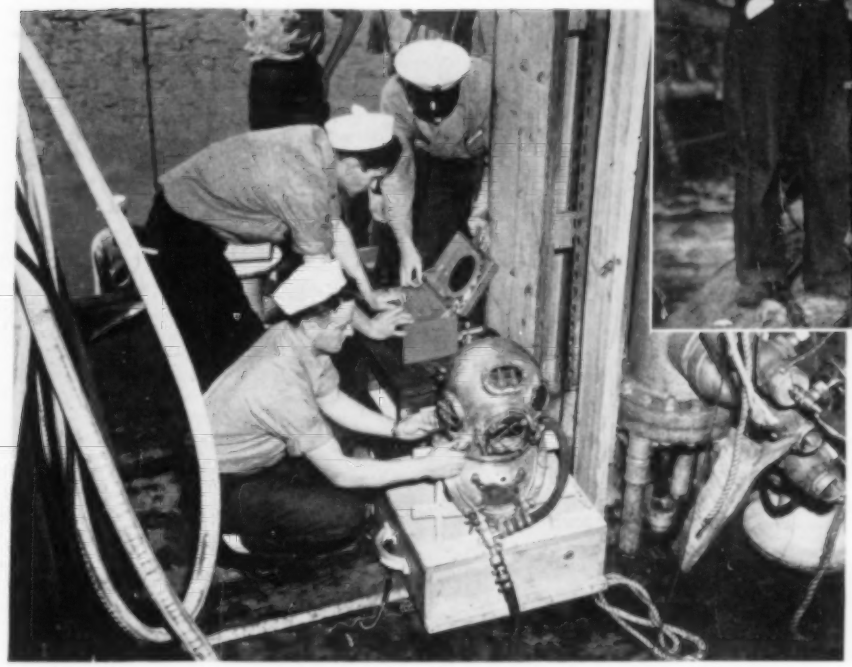
After this combing of his character, qualifications, and attitude towards the course, the enrollee still has another hurdle to clear. He is made to read, mark, and mentally digest a lesson contained in a short description of work attempted successively by three divers. The first, so the account goes, returned to the surface with several reasons why he could not do the job assigned him. The next reported that he could have completed the work but for the inefficiency of the divers that had preceded him. The third did what was expected of him and made no remarks. The object of the lesson is to drive home the fact that there is only one way to do a given job.

The arrivals undergo a physical examination which most of them pass because they have previously been examined for admission to the Navy. The few that are "physically disqualified" to become divers may go through the school and become members of salvage crews. Many otherwise sound men cannot "pop their ears"—equalize the pressure on both sides of the eardrums, which is indispensable in men working under compressed air. Some become panicky when enveloped by the metal helmet and the rubber suit. This is what the professional man designates as claustrophobia. To determine whether they can adjust their ears to air pressure, the students enter a recompression chamber that holds twenty and in which the pressure is built up to a maximum of 44.5 pounds. This is equivalent to water pressure at a depth of 100 feet. Those that cannot meet the test and those that have a morbid dread of confined spaces may be trained for above-water salvage operations.

The final preclass routine stint is an actual submergence. For this the youngsters are prepared with studied care, including a full explanation of all the fea-

LEARNING THE PHONE SYSTEM

Trainees are being instructed in the arrangement of the 2-way telephone in the diving helmet and how to operate the switchboard of the transmitter and receiver used on the surface. The latter device is shown at the right. By means of it a diver's attendant keeps in touch with him at all times. He can also hook up two divers working underwater on the same assignment and listen in on their conversation.



tures of a diving dress and the reasons for them. Each is lowered to the bottom of the slip alongside Pier 88 where the water is about 40 feet deep and so thick with silt and sewage that the diver is enveloped in darkness too dense for artificial light to penetrate. On this crucial dive the novice opens and closes the valve which regulates his vital supply of compressed air; operates the chin button of the exhaust valve which controls the flow of air through the helmet and which, incidentally, is the means of preventing the diving dress from becoming dangerously buoyant or overinflated; and talks and receives messages through the telephone in his helmet. About ten minutes elapse from the moment he is lowered to the river bed until he is brought up to the surface.

Most of the men pass the test; those who have no bent for diving usually disclose in one way or another why they do not want to continue. The students are quickly classified, and those not likely to be useful for surface salvage work are returned or transferred to the pool of General Detail at a nearby pier where they are trained for other naval duties. Those who are accepted are assigned while waiting for the classes to begin to what is known as Work Detail, which embraces activities likely to be of real worth to the men and to the fighting fleet. For instance, small groups, with an instructor, may be sent to the Brooklyn Navy Yard where they are given the job of burning scrap metal with cutting torches to learn how to handle those tools.

The course averages fourteen weeks, but may be extended somewhat for certain students if that is deemed advantageous. It begins with the intensive study, usually for two weeks, of the following subjects, which are taken up in the order in which they are given: Diving signals; construction and design of air-control, exhaust, and nonreturn valves; diving dress, its maintenance and repair, which involves a knowledge of patching materials such as cement, rubber, and cloth; causes and treatment of air embolism, caisson disease, and "squeeze"—the result of hydrostatic pressure dangerously exceeding the pressure of the air in the diving dress; how the diver should handle himself while submerged; planning and arranging for a dive, as well as set-up of the diving gear and air system; communication system; diving mathematics, including volumes and pressures; fundamentals of mechanical drawing, naval ship construction, and blueprint reading; patches to close openings in a sunken ship and how to apply them; making templates while submerged to serve as guides in fashioning patches; and buoyancy and displacement of vessels. When these topics have been dealt with they are reviewed, and this is followed by a final examination.

The men that pass then start training underwater from one of two floats in the slip alongside Pier 88, experienced divers serving as instructors and as tenders for the students. Because the tasks assigned our salvage divers may be in any climate and under any weather condition, operations are carried on 24 hours a day, rain or shine, summer and winter, even when it is necessary to break through the ice. Each aspirant diver spends ten days first on one and then on another of three shifts—Navy hours being designated from 1 to 24, starting at midnight. By thus working day and night, the student overcomes any hesitation about entering deep water after nightfall.

At the outset, the 8-hour day is directed to basic training—dressing and tending divers and operating, repairing, and keeping the various valves in perfect condition. This is followed by repeated dives, during which the novice practices the prescribed life-line signals and learns how to equalize the air pressure in his suit when descending and how to control his buoyancy upon returning to the surface. Further, he is required to rig all diving equipment preparatory to conducting underwater operations.

The importance of the compressed-air supply and the maintenance of an ample volume under all conditions is not generally realized. The school air plant consists of two Ingersoll-Rand Type 40 Motorcompressors—one in reserve while the other is running—that store air at 100 pounds pressure in three sizable receivers. These machines furnish all the air needed by the divers and the pneumatic tools used by them. Until about 1915 it was the prevalent understanding that a diver could get along with air circulating through his helmet at the rate of 1.5 cfm., measured at atmospheric pres-

sure, per number of atmospheres of "absolute pressure." Absolute pressure is normal atmospheric pressure at sea level, about 15 pounds, plus the hydrostatic pressure at the depth of submergence. That was when manually operated pumps provided the air, when the submerging depth was limited, and when the diver not infrequently suffered from bends, and even perished. Today, the use of compressors and receivers, in which the air is cooled, makes it possible to supply him with 4.5 cfm., with resultant wider freedom of action underwater, greater security, and deeper submergence.

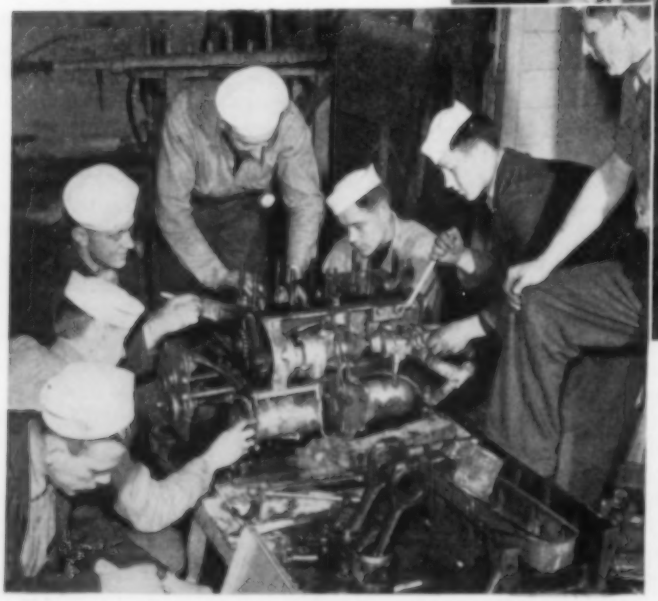
Before long the diver-in-the-making is ready for preliminary tasks underwater. He assembles pipe fittings; bolts together flanges on steel plates; or takes down with him a 4x4-inch timber 8 feet long and secures it with a line to a submerged weight. He returns to the surface only to descend again to release the timber and bring it up. Among other stunts he is required to construct a box, a difficult job in the inky darkness. He is given six sawed boards tied with rope, just 24 nails fastened with a string to his belt, and a hand hammer attached to his wrist with enough line to give him freedom of movement. It is then that the novice wishes he had at least three hands. The trick is to keep any of the boards from getting away and floating to the surface. Should that happen he is reminded by telephone from "topside" of his misdoing in the salty vernacular of the sailor. But should he reappear in good season with his job properly done, that will win for him a good grade.

Fully equipped, the student learns to swim at the surface by adjusting his exhaust valve and controlling the air in his suit so as to maintain the required buoyancy. The same nicety of control enables him to hold himself suspended in the water at any depth or to drop quickly to the bottom without inviting a fatal "squeeze." Next comes "stage diving" —the method by which a diver is put in the water from shipboard and returned from a deep submergence. This is facilitated by two metal gratings on which the students stand. These are raised and lowered by wire cables operated by air-driven hoists of the "Tugger" type. The youngsters are also taught how to use an air lift in pumping water, mud, sand, etc., out of a sunken craft and how to handle the high-pressure hose by which tunnels are dug under a ship for the passage of lifting cables.

As the course proceeds the student learns, while in diving dress, to cut metals with a hacksaw, to pour cement in a wooden form, and to work with calking irons. Another important operation is the construction of a bulkhead. Two divers are sent below for that job. With hook bolts they secure 8x12-inch, 10-foot tongue-and-groove timbers to an angle-iron frame. When finished, the structure is lifted to the surface for approval by the instructor. On Pier 88 there is a diving tank in which the aspirant undergoes a 3-week training period. But before entering the tank and doing practical work he spends a quarter to half an hour daily becoming acquainted with the flame or arc equipment used in cutting metals underwater. Upon completion of this course he is given ample opportunity in the tank to become proficient in this phase of submarine salvage and in welding flat or vertical beads.

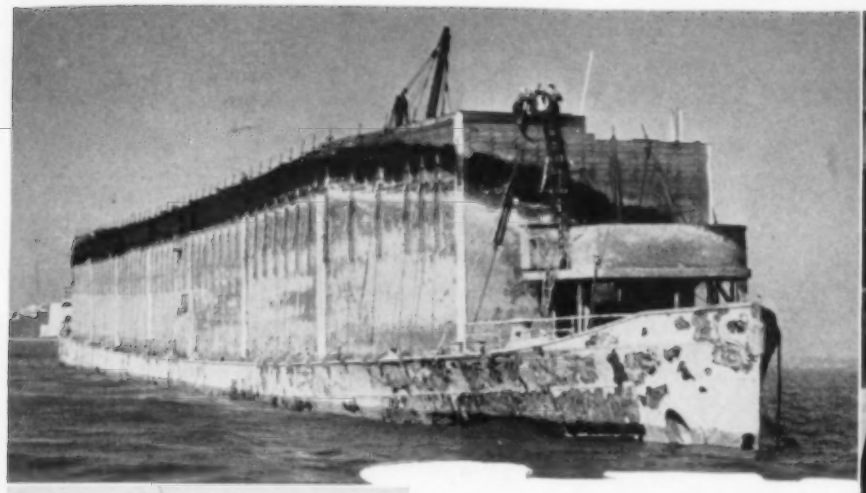
The final underwater test calls for the use of pneumatic tools that are of great aid to the diver because they do much of the hard work that would sap his energy and cut short his stay submerged. With some he drills holes in steel plates, cuts off rivets, and drives spikes in timber; with an impact wrench he bolts plates together and not only runs nuts down snugly but also off in removing apparatus from a sunken vessel. Woodborers have their applications, and Jackhamers serve to put practice holes in concrete slabs from 8 to 12 inches thick preparatory to going below and drilling holes in rock, etc., to be removed by blasting. The students are cautioned against abusing the air-driven tools and are required to keep them in service condition.

While qualifying in diving, the men are taken up the Hudson to a cove near George Washington Bridge where the slope of the bottom enables them progressively to work in water up to 150 feet deep and to hold their stations on the river bed against strong tidal currents. The two launches that transport them are fitted with gasoline-driven compressors, and these furnish all the air needed. The training is thus broadened



ENGINES AND ROPES

Instruction in many mechanical fields enters into a diver's schooling. The boys at the left are learning the operating principles of the internal-combustion engine and also how to dismantle it and reassemble it. Oftentimes, in floating a stranded ship or in taking off her cargo, it is necessary to use a "high line" extending between the salvage vessel and the one that is aground. The students above are being taught how to rig and to handle a high line.



REALISTIC TRAINING

When a vessel was recently scuttled in New York Harbor to prevent flames from reaching her cargo of explosives, diving-school students had a chance to put their teachings into practice. The first step was to cut away parts of the superstructure of the partly submerged ship (left). Then, after a cofferdam had been erected atop of her, the craft slowly rose as water was pumped out of her (right). At the left, above, the boat is shown afloat with her surmounting steel-and-timber cofferdam.

considerably beyond that practicable in the slip at Pier 88.

The prime test of diving and salvage fitness is that of inspecting a wreck such as was offered recently in the Port of New York when a vessel was scuttled to prevent the flames from reaching her cargo of explosives. Operating on the bottom where vision is obscured, the student must by touch alone obtain a mental picture of the craft after an inch-by-inch inspection and, upon returning to the surface, make a sketch of his findings. By comparison with a sample sketch, it is then possible to determine the correctness of his deductions.

Lieutenant McLagan prefers to train green men rather than those who know something about diving. His reason is that the novice is easier to lead in the right way while the other may have to unlearn much to harmonize his actions with the newer submarine-salvage methods. Older divers often are opposed to telephones in their helmets because the earlier ones were unreliable. The instrument now used by the Navy is a vast improvement. It permits continual vocal intercourse between diver and tender, while the latter can connect one diver with another and listen in the while.

The salvage diver has to be amphibious and is taught to deal with phases of salvage operations apart from the underwater work of saving a ship, recovering as much as possible of her valuable cargo, armament, instruments, confidential documents, etc. For two weeks the student is instructed in seamanship so far as it concerns an understanding of that subject in general and salvage work in particular. This includes a basic knowledge of the construction of fiber and wire rope, of their handling, tying of knots, splicing, and of fastening them—all of which is essential ashore or afloat where the services of a rigger are needed. The student becomes adept in the use of shipboard rigging and learns to reeve tackles and purchases—pulleys and multiple lines to the layman, especially the heavy beach and "high-line" gear. Beach gear consists of wire and hemp cables, of salvage anchors, lengths of chain, etc., and is utilized to pull a stranded ship back into deep water. In the rigging loft at Pier 88 is an adequate supply of boatswain's stores, and each class is required to make a set of wire-rope straps for the outfitting of a salvage ship, as well as other similar equipment. Every phase of the training goes forward by typically up-to-date methods, and the men are encouraged to show initiative.

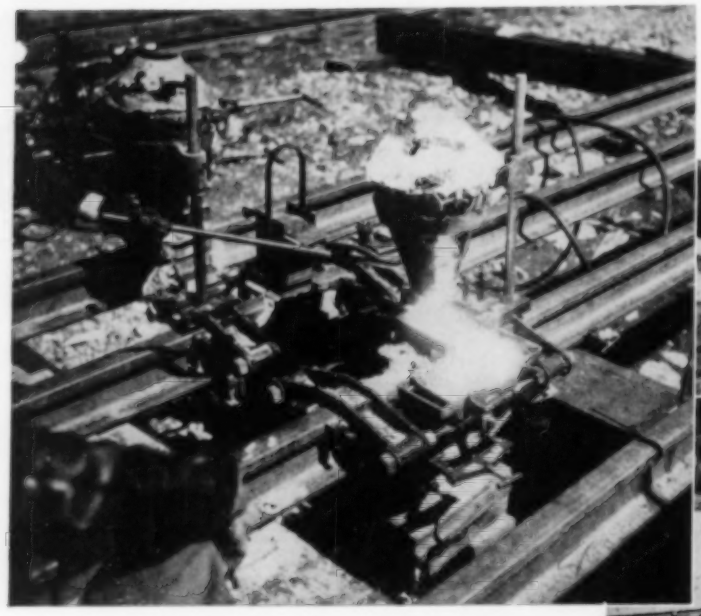
Because oil and gasoline engines now play a big part as prime movers in salvage work, the school has a Motor Room where the students first become familiar with the tools used in motor overhaul. Next, they are taught the operating theory of internal-combustion engines and their distinctive basic principles. This includes instruction in ignition wiring, ignition and valve timing, firing order, etc. The concluding work involves overhauling engines, pumps, generators, and compressors. There is also a Carpenter Shop where some of the men showing aptitude are given special carpentry assignments as their stints under Work Detail. These picked men help to keep every department of the school in perfect repair and will be of value both in salvage operations and aboard ship.

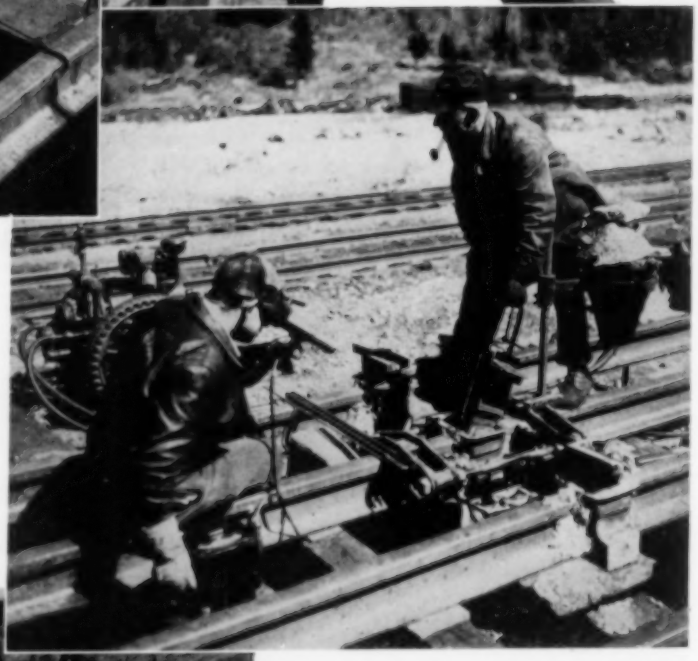
Persons privileged to visit Pier 88, will find the Model Room especially interesting. There, in miniature, are reproductions of outstanding salvage jobs done by the Navy, and the forms of the cofferdams, patches, etc., employed in each case. These models reveal the basic principles underlying each structure, and to the student provide lasting pictures that will aid him when confronted by similar problems. After passing his final examination, each graduate—Salvage Diver or Diver 2nd Class—is given a loose-leaf book, his treasured log, that is a compilation with detailed sketches of the newest and most approved methods of marine salvage.

The graduates of the Navy Salvage School have been sent for active duty to many sea areas where the expanding battlefronts of our Navy and the cargo carriers serving them have suffered damage because of enemy action or stress of storm, collision, or grounding. There it has been brought home to them that the work for which they have qualified may be packed as full with drama and grim action as that of any other branch of the fighting fleet. Saving where the enemy has sought to destroy may be as hazardous as facing a foe's attack.

Six Miles of Rails and No Joint Anywhere

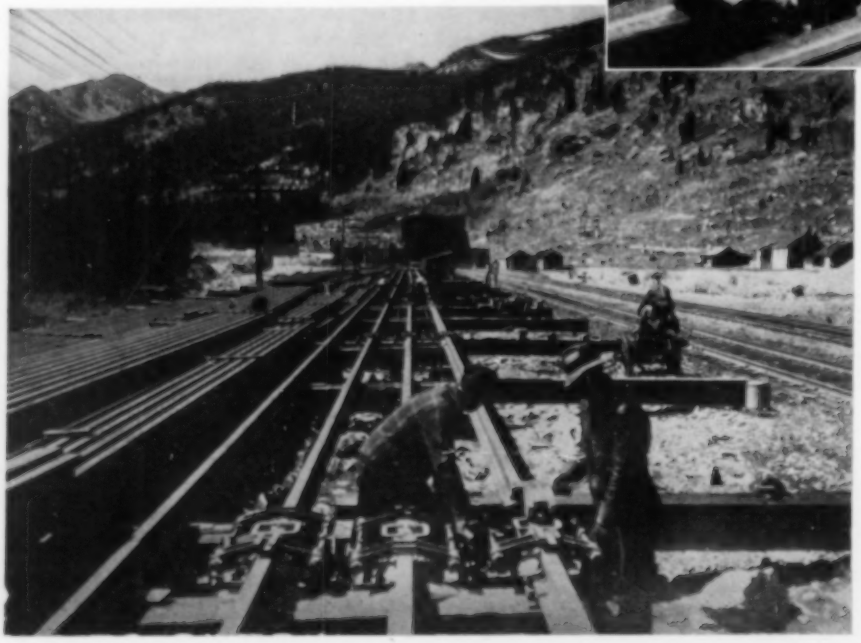
Merritt L. Smith





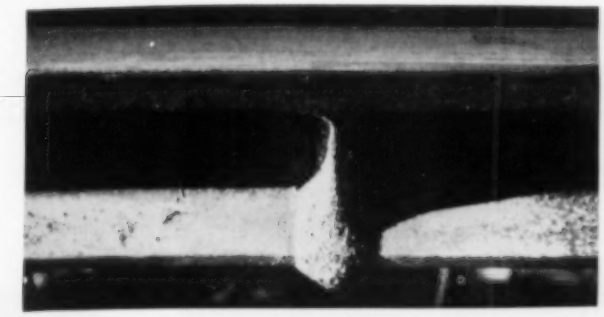
WELDING OPERATIONS

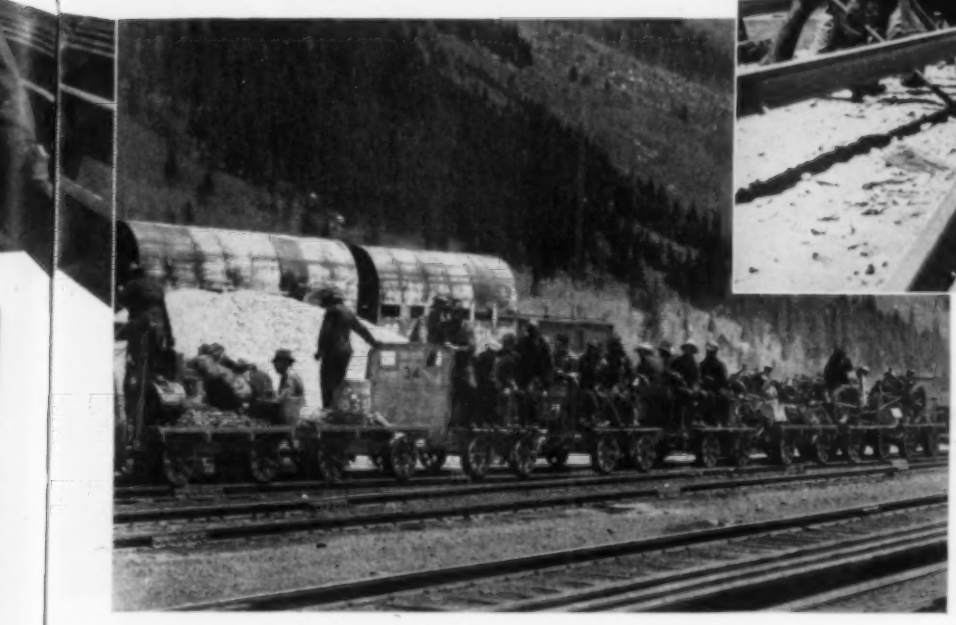
Below is the storage and working bed at the tunnel portal showing four paralleling 1,000-foot sections made up of 39-foot, 130-pound rails carefully lined up and clamped. Welding was done in groups of four. The men in the foreground are seen putting the lower halves of the molds in place. Preliminary to welding, the rail ends were preheated to a given temperature, which was determined by sighting through an optical pyrometer (right). The Thermit in the crucible was then ignited and tapped (above), permitting the white-hot metal to flow into the molds. The high-speed precision grinder with which the top and sides of the rail head at each joint were leveled is pictured at the top-right.



TODAY'S heavy freights and crowded railroad schedules are hard on track. Particularly do they raise havoc with rail joints—the weakest points of the whole track structure. The incessant pounding of locomotive drivers and car wheels batter and cup out rail ends, loosen bolts and bonds, knock track out of line and surface and, all in all, lead to excessive upkeep. It has been estimated, for example, that nearly half the cost of maintaining track on the average Class 1 Railroad may be traced directly to wear and tear at the rail joints. In tunnels, especially, is the rail joint a real problem. There constant moisture and locomotive exhaust gases combine to add the factor of corrosion.

In the Moffat Tunnel on the Denver





READY TO GO INSIDE

With a group of 1,000-foot rail lengths welded, they were successively barred onto and spiked to ties (above) and skidded into the tunnel by means of a small diesel locomotive. When six or more were in proper position, the crew with all its equipment (left) moved in to make the closure welds. At the top-left is a close-up of a joint, showing the smoothness of the running surface.

& Salt Lake Railroad, this matter of corrosion was serious, necessitating frequent renewal of joint bars, bolts, and bonds and shortening rail life to the point where track-maintenance costs were entirely out of line. This famous single-track tunnel is 6.2 miles long, and saves more than 150 miles of travel between Denver and Salt Lake. Completed in 1927 after four years of construction, it pierces the Rocky Mountains some 50 miles northwest of Denver and at an altitude of more than 9000 feet, almost a mile below the towering peaks.

An interesting feature of the tunnel is the method used to ventilate it—to exhaust the smoke and fumes. At the eastern entrance there is a heavy canvas curtain and a blower house containing a large electrically driven fan. With each passage of a train the curtain is dropped, the fan is started, and the smoke is blown through the entire length of the tunnel and out at the opposite end. Ten to twenty minutes are required to carry out the operation. An Ingersoll-Rand diesel engine does standby duty in the blower room and is frequently called upon to drive the fan when summer thunderstorms or winter blizzards interrupt electric-power service.

As a solution of the track-maintenance problem, engineers of the railroad determined to eliminate the rail joints in the tunnel by laying rail welded into continuous lengths from portal to portal. The Thermit welding process was selected for this job because of its simplicity and adaptability, because the equipment used is compact and portable, and because the resulting welds are strong and dependable.

A Thermit weld is made in somewhat the same way as a casting is produced. A mold is placed around the part to be joined; the parts are preheated to a bright-red heat; molten steel, obtained on the spot through the Thermit reaction, is poured into the mold; and trimming and grinding complete the operation. Thermit is basically a mixture of iron oxide, or steel-mill scale, and granular aluminum. When this mixture is ignited, a chemical reaction occurs in which the oxygen of the iron oxide combines rapidly with the aluminum, setting the iron free. The reaction generates a temperature of almost 5000°F. This purifies the iron so that it is really steel and has a strength not of cast metal but more nearly of forged steel. Other elements or oxides of elements are generally added for alloying purposes to the basic Thermit mixture, which can be varied to produce weld metal of almost any desired quality.

Outside of the east tunnel portal was built a timber structure to serve as a storage place for standard length rails and as a bed on which to weld them into continuous 1,000-foot sections. It was large enough to permit work to go on simultaneously on four such strings. As each set of four was completed it was moved to one side, and another set was shoved in place for welding. Welds were made in groups of four—that is, as one was being poured, two were undergoing preheating, while the molds were being applied to the fourth.

When a number of the long rail sections were ready for laying, they were shifted from the welding bed and spiked to ties placed crosswise on the track leading into the tunnel. Tie plates fastened to the bottoms of the ties provided riding surfaces so that a small diesel locomotive could easily skid the rails into the tunnel. There they were spiked in position and temporarily joined with heavy track clamps. With six or more of the 1000-foot lengths laid, the tunnel was closed to other traffic and the crew went inside to make the closure welds.

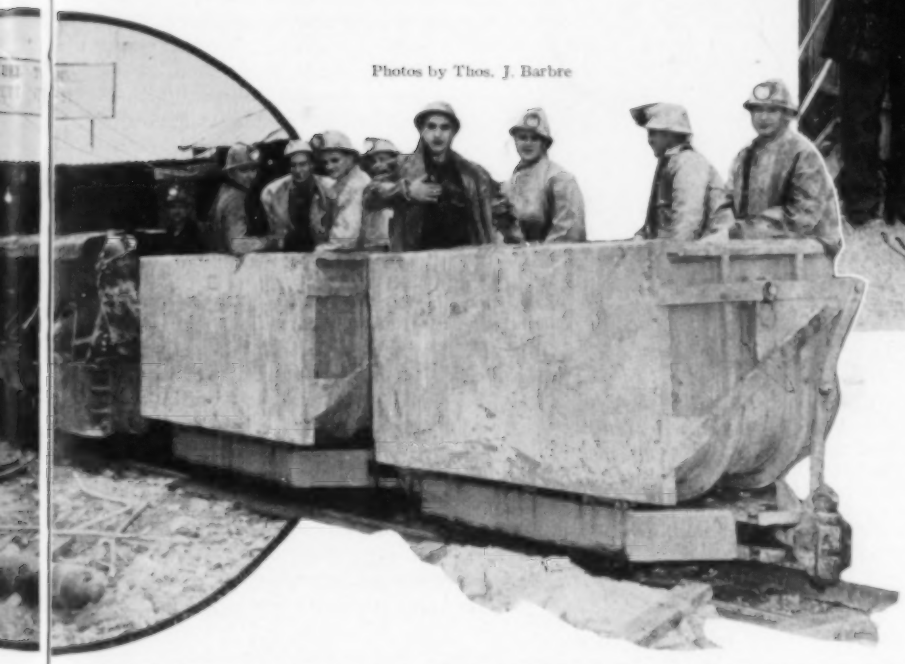
All the work was done by personnel of the Denver & Salt Lake Railway Company and of The Denver & Rio Grande Western Railroad, which operate the tunnel, and was supervised by the Metal & Thermit Corporation of New York City.

IN ORDER to obtain additional zinc, lead, and copper for the war effort, the government-financed Treasury Tunnel is being driven beneath one of the high peaks of the La Plata mountain range in the San Juan region of southwestern Colorado. From its farthest point of advance, a raise will connect it with the lower workings of the Black Bear Mine, where 300,000 tons of ore is blocked out ready for extraction. The Black Bear was formerly worked through a vertical shaft whose collar was 12,325 feet above sea level, but operations were summarily terminated in 1926 by a snowslide that destroyed most of its surface buildings and put out of commission the aerial tramway that served as its only transportation system.

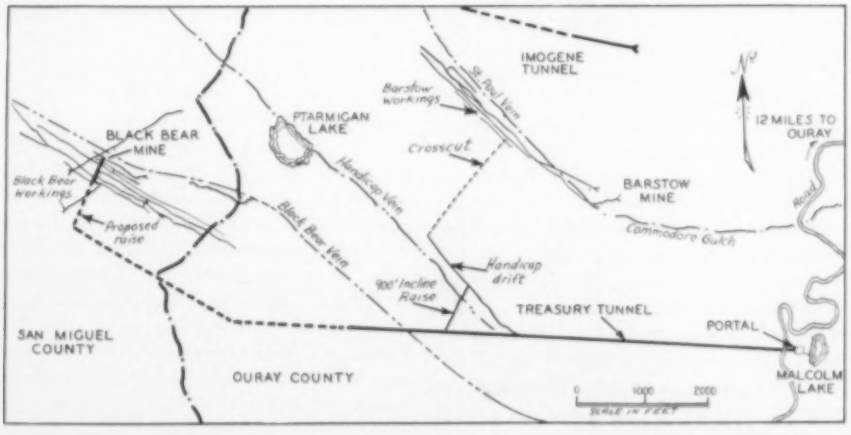
The Black Bear is on the western slope of the range, in Ingram Basin, about 3 miles from Telluride. The portal of the access tunnel is on the eastern side at an elevation of 10,625 feet and on the "million-dollar highway" that extends from Ouray to Silverton. It will be a relatively easy matter to bring the ore out, to treat it in a mill that is now being enlarged for that purpose, and to truck the concentrates 12 miles to a railroad for transshipment to a smelter. Aside from thus affording a more convenient and more economical outlet for the ore, the tunnel and raise will drain the par-

Treasury Tunnel to Reopen Old Mines

C. H. Vivian



Photos by Thos. J. Barbre



LOCATION AND PERSONNEL

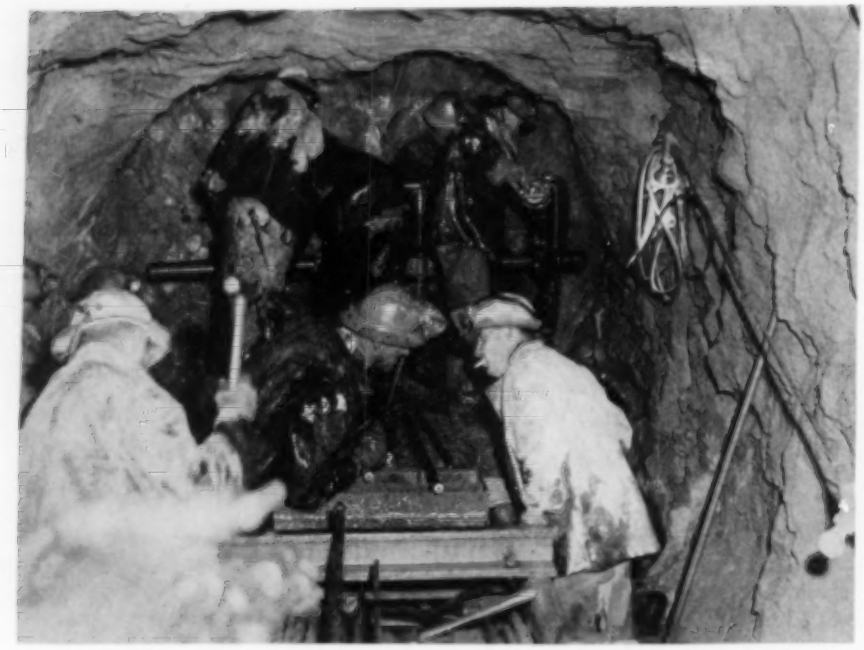
The Black Bear Mine is shown in the circle in the picture on page 10. The view was taken at an elevation of more than 13,000 feet from a point on the ridge under which the Treasury Tunnel is being driven. When the mine was previously operated ore was transported by aerial tramway 12,000 feet down the canyon to a mill at Pandora. A line drawn on a map between the portal of the Treasury Tunnel and the town of Telluride would represent a distance of 30,000 feet. Yet, because of the extreme ruggedness of the terrain, it is necessary to travel 72 miles between the two points by highway. At the top of page 10 is a general view of the Treasury Tunnel surface plant looking in the direction in which the bore runs. Workers ride into the tunnel in muck cars (left, above). In the group above, left to right, are Oscar H. Johnson, president of the Idarado Mining Company; J. D. Nicholson, sales manager, Mine & Smelter Supply Company; John Edgar, in charge of operations for the Sunshine Mining Company; and John R. Austin, veteran tunnel driver who is manager for Stiers Bros. Construction Company, tunnel contractor. The map shows the relationship of the tunnel to the mining properties that will be developed by it.

tially flooded Black Bear workings and eliminate the necessity of pumping water to the surface.

When the Black Bear ceased production, it had reserves of ore that are expected to yield 22,000 tons of zinc, 12,200 tons of lead, and 4600 tons of copper, in addition to considerable gold and silver. Its workings consist of a 650-foot shaft and six production levels, and as the vein was still strong at the lowest point of development it is reasonable to assume that the eventual output will be materially greater than the foregoing figures indicate. While the immediate objective is to produce vitally needed war metals, especially zinc, the work underway at the present time will perhaps also enable the Black Bear to carry on profitably during the postwar period.

There are other properties that will be benefited by the tunnel. Before the current undertaking was begun, the bore had already been driven more than a mile to tap the Handicap vein, this operation having extended over a period of years. From the Handicap workings a crosscut had been driven to reach the Barstow vein in the mine of the same name. From the Barstow Mine another opening can be driven to the Imogene Mine. The tunnel, may, accordingly, be considered to be a project that will make possible the operation of four properties on a unit basis with attendant economies that may result in years of future activity. All the mines save the Imogene have been worked intermittently for 40 years or more and have made money during times of favorable metal prices.

The properties concerned have been grouped under the ownership of the Idarado Mining Company, which has, in turn, leased them for a period of five years to the Metals Reserve Company, a subsidiary of the Reconstruction Finance Corporation, which is advancing the funds required to drive the tunnel and raise and to double the capacity of the 250-ton mill that was built at the portal of the bore several years ago. The lease was signed on June 4, 1943. The



DRILLING THE ROUND

A view along the deck of the drill carriage—a 7-ton, all-steel, ball-bearing wheeled structure carrying five DA-35 power-feed drifter drills in front and one at the rear. A full complement of Jackrods for each machine and sharp Jackbits for a round are carried on the rear end. Nippers working in the foreground change bits as they are required and keep the supply of steel moving to the drill runners ahead. At the instant the photograph was taken, a chuck tender and a nipper were trying to iron out some difference pertaining to steel length and were apparently having difficulty hearing each other amid the heading din.

Metals Reserve Company has designated the Sunshine Mining Company as its agent to do the necessary preliminary work, which was started in July. John Edgar, chief engineer for Sunshine, which is a prominent operator in the Coeur d'Alene District of Idaho, is in charge of the development. The driving of the tunnel was contracted by Sunshine to Stiers Bros. Construction Company of St. Louis, Mo. John R. Austin, who drove the 32,000-foot Carlton Tunnel at Cripple Creek, Colo., in record time and who is directing work for the Stiers firm at the west end of the Continental Divide Tunnel in the same state, is manager of the Treasury Tunnel operations. R. C. Blasongame is tunnel superintendent, and Robert L. Pestana is office manager. More than 100 men are employed.

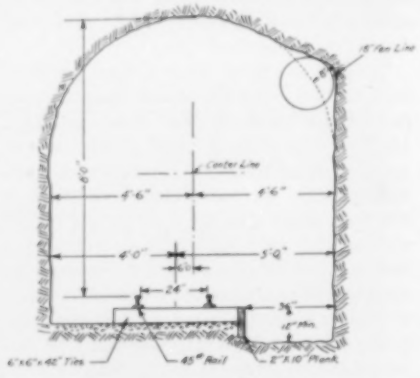
The area in which this job is progressing has a colorful, although checkered, mining history. Placer miners who followed the auriferous gravels up the San Miguel River in 1875 soon afterward found lode deposits in the elevated cirques that rim its headwaters. A town called Columbia was established, but the post office was named Telluride because gold was found in combination with tellurium. Telluride was incorporated in 1878, but it was not until four years later that a road was built into the section from Montrose. Meanwhile, other placer miners had worked up the Uncompahgre River on the opposite side of the mountains and made important mineral discoveries in the vicinity of what is now Ouray. Both districts experienced the tempestuous booms typical of their day, and prospectors swarmed over the surrounding mountains. In 1890 the Denver & Rio Grande Railroad was extended to the two towns.

Many notable mines were developed in the area, the most celebrated among them being the Camp Bird. Other important properties were the Smuggler-Union group, the Revenue, the Tomboy, and the Black Bear. All started out as gold and silver producers, but as they were deepened encountered sulphides of zinc, lead, and copper. The ore was complex and hard to treat by the milling methods then known, and a considerable proportion of the metallic content undoubtedly was not recovered. Another complication was the exceptionally rugged terrain. Most of the mines were located high up on the precipitous peaks, and were virtually inaccessible by roads. Aerial tramways had to be erected to move supplies in and ore out, and the region abounded in these systems, many of them so steep in some parts that their construction with the means then at hand amounted to real engineering achievements. At these high elevations, winter snows commonly accumulate to depths of 30 feet and more, and slides such as the one that all but obliterated the Black Bear surface plant are the rule rather than the exception. Under these austere conditions, mining operations were difficult, to say the least, and often so costly that it took good ore to show a profit.

Despite the drawbacks, mining prospered there for many years. The biggest production period was roughly the first quarter of the present century. Between 1897 and 1919, San Miguel County, in which Telluride is located, had an accredited output of more than $2,000,000 annually in gold, and it exceeded $1,000,000 in each of the five following years. From 1897 to 1924 the annual silver production never fell below 1,000,000 ounces, and in 1923 it totaled 1,982,007 ounces. During the same span the lead yield averaged 5,000,000 pounds a year and reached a peak of 9,360,637 pounds in 1923. The output of zinc was small in the early part of this period because it was difficult to extract, but with the improvement of metallurgical processes production mounted.

The veins are characteristically filled fissures in andesite, rhyolite, or San Juan tuff. They average from 30 to 48 inches wide and are remarkably persistent, some of them extending 7000 feet or more. Below the igneous rocks just mentioned are horizontally disposed sedimentaries, and it still has not been definitely determined whether the mineralization generally persists in them. The veins normally carry from 2 to 3 per cent of sulphides, consisting of pyrite, chalcopyrite, sphalerite, and galena, with some gold and silver nearly always present.

The Camp Bird Mine attained widespread publicity because of the fortune it produced for Thomas F. Walsh, father of Mrs. Edward B. McLean, for years prominent in Washington, D.C., and owner of the Hope diamond. At the time Walsh came upon it, the Camp Bird was under lease to two brothers who were apparently so intent upon looking for silver in a lead-zinc vein that they threw gold-bearing quartz on the dump. Walsh recognized the value of the latter and bided his time until he could get control of the property. He operated it successfully from 1894 to



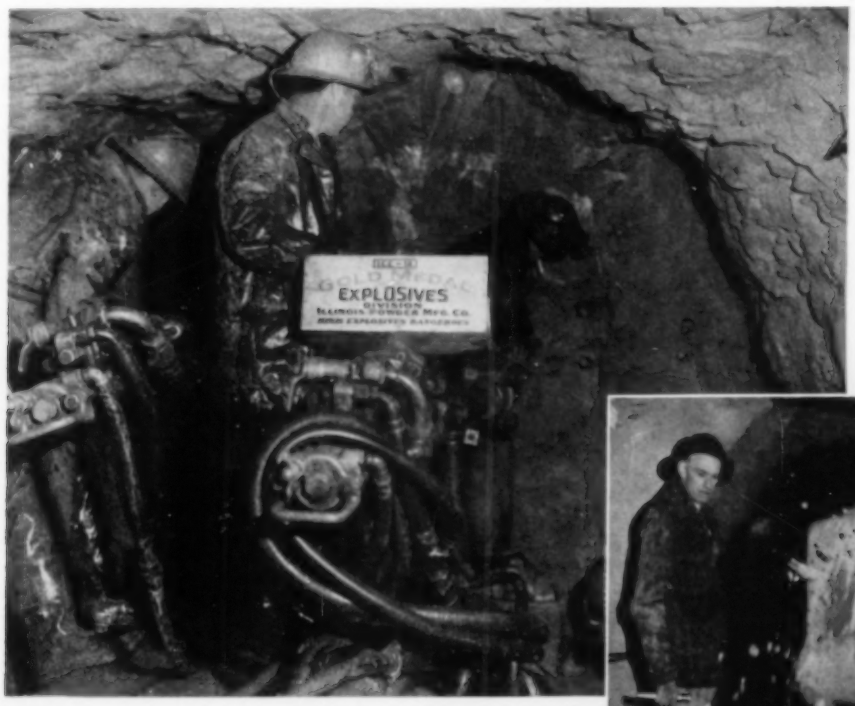
TUNNEL CROSS SECTION

1903, and then sold it to Camp Bird Limited, a British syndicate, that was formed by F. W. Baker and John Hays Hammond to take it over. Walsh received $5,000,000 in cash and an additional $2,000,000, which was paid out of profits. Under British ownership, the mine yielded handsome returns for ten years. Then the lower levels began to show impoverishment, and by 1916 the known ore deposits were thought to be virtually exhausted. During the ensuing ten years only intermittent work was done; but since 1926 King Lease, Inc., has operated the mine continuously and successfully and added to reserves that were once considered nearly depleted. The Camp Bird is at an elevation of 11,000 feet and 8 miles from a railroad, and during all its operating years supplies and equipment have had to be hauled in and concentrates from the mill hauled out. E. R. Baur, for many years secretary to Mr. Walsh prior to the latter's death in 1910, is timekeeper at the Treasury Tunnel—not through force of circumstances but because he prefers to live in the section he knew so well in the heyday of its mining prosperity.

Another less publicized but profitable mine was the Smuggler-Union. The Smuggler was located in 1875; and, together with the Sheridan and Mendota, was sold in 1883 to a group of Englishmen most of whom resided in China. A mill was constructed at Pandora, on the railroad near Telluride, and a mile-long aerial tramway run from it to the property. For several years it was credited with being the largest mining operation in Colorado, and the early ore is reputed to have averaged $50 to the ton. In 1891 the properties were acquired by the Smuggler-Union Mining Company, which was controlled by the New England Exploration Company, a Boston concern. The president of the latter was T. L. Livermore, and one of the directors was R. L. Agassiz, chairman of the board of the Calumet & Hecla Consolidated Copper Company whose Michigan mines were outstanding copper producers. A year after being graduated from Harvard University in 1894, Bulkeley Wells married a daughter of Mr. Livermore, and in 1896 he assumed charge of the Smuggler-Union operations. Wells achieved outstanding success; and, though the company never published financial reports, it was generally known that appreciable profits were made. In 1928 the mining equipment was bought by Grimes Brothers of Denver, Colo. The 1929 edition of the *Mines Handbook* credits the Smuggler-Union with an output of $60,000,000 in its 53 years of activity.

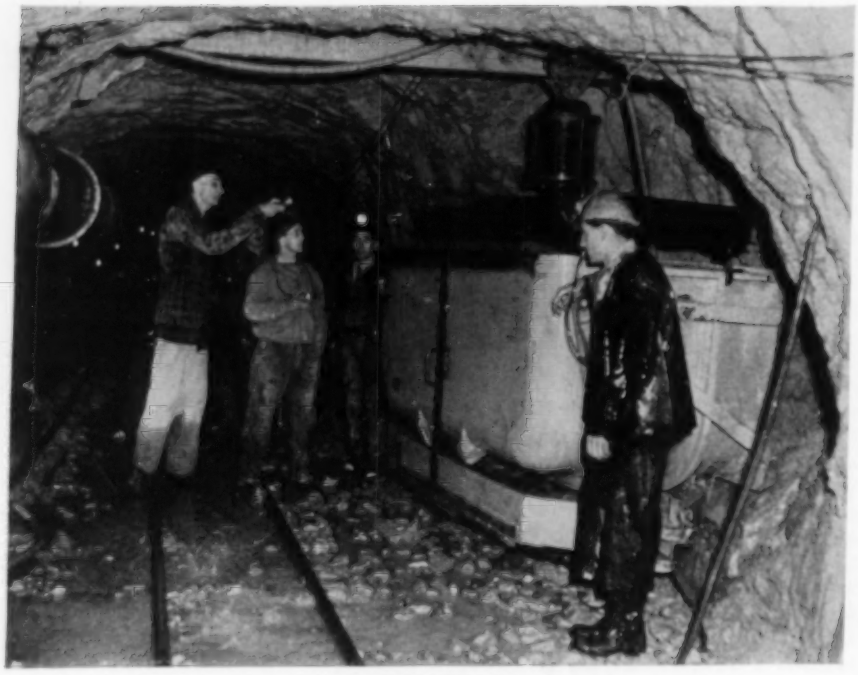
Near the Smuggler-Union is the Tomboy, another mine that was under British domination for a number of years after having been opened up by Americans. It paid its overseas owners dividends aggregating nearly three times their investment. Mention of these properties is made here because of their general interest and because their long records of profitable production indicate the extensive and persistent character of the ore bodies in the area into which the tunnel is being driven.

The Black Bear Mine was discovered by Finnish mining men from the iron country of Wisconsin. They incorporated the Black Bear Mining Company in 1894 and placed Ike Partenan in charge of the operations as engineer. A 12,000-foot aerial tramway was built to the Smuggler Mill, at Pandora, where the ore was treated. The vein is believed to be an extension of the Argentine vein in the nearby Tomboy Mine. The original owners gave up after operating the Black Bear for a number of years, and in 1912 it was purchased at sheriff's sale by Harry Payne Whitney, New York financier and sportsman. Whitney put Bulkeley Wells in charge of it, and under his skillful direction it became a good producer and continued so until



LOADING HOLES AND MUCKING

A typical drill round consists of 32 holes 7 feet deep, and into them goes approximately 200 pounds of dynamite to shatter the rock. Blasting is done with electric-delay caps fired from a safe position 1,500 feet back from the heading. Broken material, amounting to some 28 cubic yards per round, is loaded (right) into 90-cubic-foot cars by an Eimco loader operated by compressed-air motors. As the scoop swings up and over, rock showers from it, while "Long John" Austin, looking on at the left, seems perplexed about something.



CHERRY PICKER

Empty cars are switched to the head of the muck train as needed by this conventional device. Each is lifted from the tracks by an air cylinder and then pushed aside to permit the loaded car coming back from the heading to run past it.

the snowslide of 1926 enforced a shutdown. The expense of rehabilitating the property was considered too great to be warranted, especially since there was a continual threat of further slides. Ownership passed successively to the Whitney estate, the Colorado-Superior Mining Company, and then to the Telluride-Black Bear Mines, Inc., a group of Portland, Oreg., people that held it until it was taken over by Idarado.

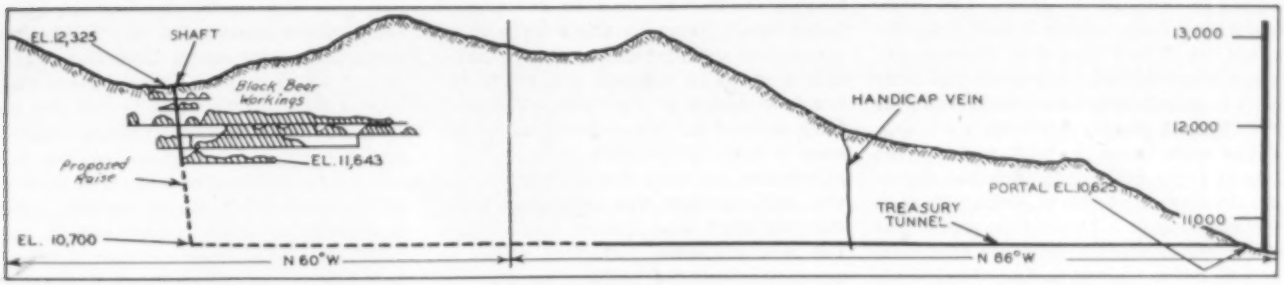
This section of the country is of historical interest to engineers for a reason other than its mining activities, for it was at Telluride that the first successful transmission of alternating current in the United States was made. During the eighties, when electricity was slowly coming into service for lighting by arc and incandescent lamps, alternating current was not known. Direct current gave satisfaction; but as it was not readily transformable to a higher or lower voltage, it was generated at the low voltage at which it was used and had to be transmitted at that voltage. An elementary transmission fact is that the quantity of current that can be passed over a conductor economically at a fixed voltage depends upon the size of the conductor. If the volume of power is great and the voltage low, the conductor must be large. Because of the cost of large copper wires, the expense of transmitting direct current any considerable distance became prohibitive. For that reason, lighting plants were generally set up in the buildings in which the current was consumed. Central stations for commercial lighting began operating in 1882, but it was soon apparent that current could not be conducted more than a few hundred yards at reasonable cost.

It was during this period that George Westinghouse turned his thoughts to electrical matters—when he began to use electric circuits for controlling the railroad signaling and interlocking devices that he had developed. He started making direct-current lighting plants and installed the first one in the Windsor Hotel in New York in 1886, soon becoming a big factor in that field. In common with others in the industry he recognized the limitations of direct current and sought ways of overcoming them. While in Italy in 1882, Westinghouse became interested in a process for making artificial marble from gypsum and arranged for two men to come to the United States to manufacture the product here. One of these was Guido Pantaleoni, newly graduated from the University of Turin. The synthetic-marble venture was not a success, so Pantaleoni was assigned by Westinghouse to work with the Union Switch & Signal Company.

In May, 1885, the young Italian was called home by the death of his father, and while at Turin he met Lucian Gaulard who had just installed between Lanzo and Circe an alternating-current system of distribution patented by himself and John Dixon Gibbs. Pantaleoni cabled Westinghouse, and the latter promptly arranged to obtain the American rights on the system, which involved the use of a "secondary generator" or transformer. He also had a number of the transformers and a Siemens alternating-current generator sent to Pittsburgh, where, during the next few years, he improved the design of the transformer. Late in 1885 the dynamo from abroad was set up in Great Barrington, Mass., wires were strung to various nearby stores, and a transformer was placed in each one for stepping down the current for lighting circuits. The first commercial alternating-current transformer installation was made in Buffalo late in 1886 and was followed by various others throughout the country.

This sponsorship of the system by Westinghouse met with great opposition. Articles in the press and trade journals called alternating current dangerous and deadly, and leading electricians took stands against it. Some of the attacks were no doubt attributable to the fact that any change from the prevailing direct-current system would entail replacing existing equipment at considerable expense. Westinghouse himself seems to have been feeling his way. His first work had been with the air brake, and he was compressed-air minded. For years he had envisioned piping air along railroad lines to operate switches and signal systems, as well as cranes, riveting hammers, and other tools. There was no originality in this thought, for compressed air had long been distributed in Paris for actuating small machines. In the late eighties there was advanced the scheme for generating hydroelectric power at Niagara Falls and sending it to a nearby industrial center and also to Buffalo, some 20 miles distant. When a call for bids was made in 1891, four firms submitted proposals that involved transmitting the power by means of compressed air. In his early discussions with the commissioners in charge of the development, Westinghouse himself had suggested using compressed air for that purpose, but he changed his mind as a result of the fortuitous success in transmitting alternating current at Telluride.

The Telluride installation was made in 1890. Some of Westinghouse's young assistants were much more enthusiastic about the possibilities of alternating-current distribution than he was, and it was at their insistence that he consented to bid on a small plant in Telluride consisting of a 100-hp. water-driven generator and an alternating-current motor, both wound for 3000 volts. The transmission distance was only 3 miles, but there was a notable saving of copper wire as compared with the direct-current system that was offered by the Edison interests. The Telluride scheme was successful and had a far-reaching effect on the electrical industry. It definitely made up Westinghouse's mind on power transmission, and his alternating-current



TUNNEL PROFILE

system was adopted at Niagara Falls. Soon afterward, alternating-current generation and transmission became standard practice, and the resultant advantages were such as to accelerate the use of electric power throughout the world.

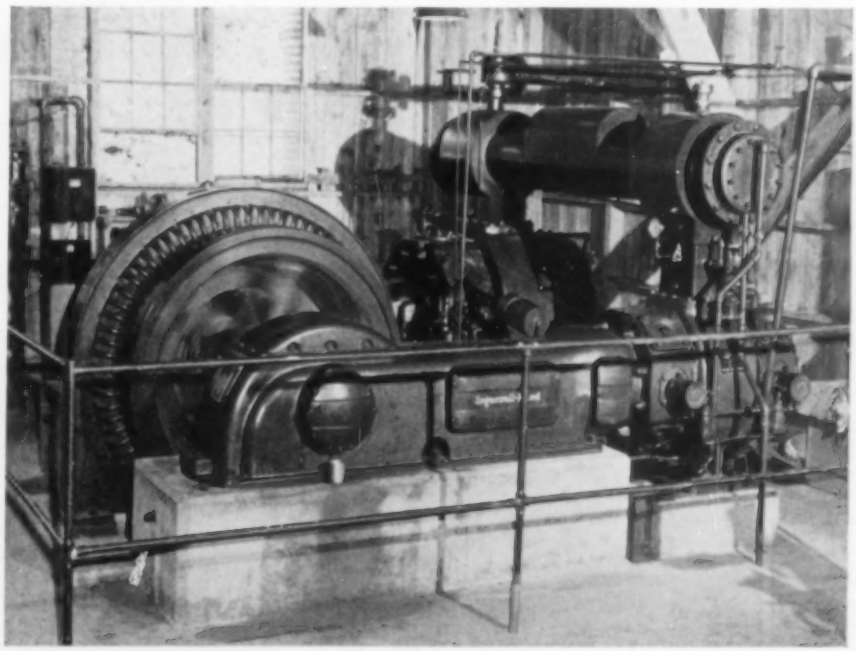
As previously stated, the Idarado Mining Company is a coalition of the various interests that own the mines that stand to benefit from the present development work. Credit for bringing this about is generally accorded to Oscar H. Johnson, president of Idarado as well as of the Mine & Smelter Supply Company of Denver. With the late A. E. Seep of Denver, Mr. Johnson acquired ownership in 1926 of the Barstow Mine, which was opened about 1901 and was operated for many years by Standard Oil Company interests and later by a number of leasers. The original Treasury Tunnel was started more than 40 years ago by a man named Hammond to work the Handicap vein. The property was idle from 1916 to 1937, when it was taken over by the San Juan Metals Company headed by Frank Eichelberger. The Callahan Zinc-Lead Company subsequently bought the Treasury Tunnel holdings; built a 250-ton mill, which is now being enlarged; and did some drifting on the Handicap vein. Through an arrangement with the Barstow Mining Company, it also began crosscutting to the Barstow Mine.

The Idarado Mining Company was formed in 1939 to acquire the Treasury Tunnel, Barstow, and neighboring properties. With the lengthening of the tunnel in mind, efforts were made to get the Black Bear into the group, and this was finally done. The Newmont Mining Corporation of New York is the largest shareholder in Idarado; and lesser interests are held, in the order named, by Sunshine, Black Bear, Callahan, and Barstow. The lease to Metals Reserve Company and the attendant financing by RFC were recommended by the Zinc Division of the War Production Board following an investigation of and favorable report upon the project made by the U. S. Bureau of Mines under the supervision of L. K. Jacobsen, district engineer for Colorado. The estimated cost of the tunnel and raise is $189,000.

When the current work was started, the tunnel had penetrated 5539 feet. It will be extended approximately 6300 feet, and from its terminus it will be necessary to drive a raise of 943 feet to the lowermost Black Bear workings. This will be a 3-compartment raise and large enough to hoist through it haulage locomotives, cars, and other mining equipment. The Black Bear vein was cut at a point 8568 feet in from the portal, and from there onward the tunnel is following the general course of the vein. The older section of the bore is 7x8 feet in cross section and the grade varies from ½ to 2½ per cent. This has imposed a problem in holding back loaded muck trains on the steeper gradients. As electric locomotives do not have the needed braking power, an 8-ton diesel, consisting of a 66-hp. International engine mounted on a Plymouth chassis, is used for main haulage, while braking is effected by running the engine on compression. The tunnel extension is being driven 9x9 feet in cross section and on a uniform grade of ½ per cent.

The procedure is essentially the same as that followed by Mr. Austin at the Carlton Tunnel, where he set new records for speed of advance. The 7-ton, all-steel drill carriage employed is substantially a duplicate of the Carlton unit, being 30 feet long, 4 feet wide with the wings folded back, and 8 feet wide with the wings raised. Five Ingersoll-Rand, DA-35 power-feed drifter drills are mounted on swinging column arms at the front of the machine and one is stationed at the rear of the carriage for drilling overhead holes in which to secure supports for the ventilating duct and the cherry picker utilized for switching muck cars. Compressed air is normally furnished by an Ingersoll-Rand 2-stage compressor of 1500-cfm. capacity, while two smaller machines are available for peak service. The discharge pressure is 125 pounds per square inch, and the air is conveyed to the drills through a 6-inch pipe line.

A typical round consists of 32 holes



SOURCE OF COMPRESSED AIR

This synchronous motor-driven compressor, equipped with 5-step clearance control, normally supplies all the air required in the tunnel, but smaller machines are available in case of need. The air is discharged at 125 pounds pressure.

drilled in pyramid-cut form. Cut holes are 9 feet deep, others 7 feet. Starter steels are 3 feet long and changes are made every 2 feet. All drilling is done with Ingersoll-Rand Jackbits. New bits are 1⅞-inch gauge, and holes are begun either with them or with resharpened bits of 1 13/16-inch or 1¾ inch size, the reduction in gauge being 1/16-inch with each reconditioning. Depending upon the size of the starter bit, holes are bottomed at 1¾, 1 11/16, or 1⅝ inches. Each bit is normally used seven or eight times.

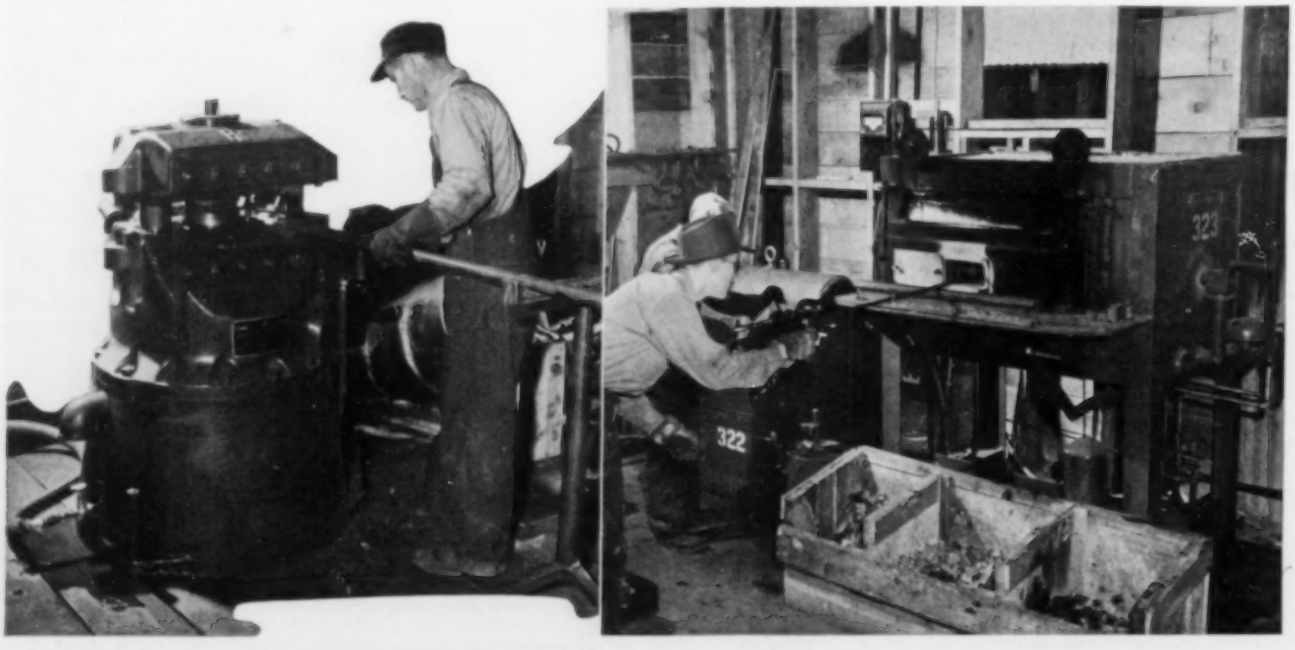
Jackbits are resharpened by Ingersoll-Rand hot-milling equipment. Dull bits are quickly sorted for gauge according to length, using a tilted slide of progressively decreasing width such as was devised by Mr. Austin at the Carlton Tunnel. From 900 to 1000 bits are milled daily. Hardening is done at night, bits being quenched on an 8-place fixture. Jackrods are threaded on a National threading machine powered by a compressed-air motor; shanks are forged in an I-R sharpener; rods are cut with a Size 500 cutoff wheel; and shank ends are ground true on the same machine, using a wheel designed for that service.

Holes are loaded with 40 or 60 per cent Gold Medal gelatine dynamite made by the Illinois Powder Manufacturing Company and are shot with 0- to 10-delay electric blasting caps, an average of 6.5 pounds of explosive being required per cubic yard. Each 7-foot round breaks about 28 cubic yards of muck, which is loaded into 90-foot-capacity Granby-type steel cars by an Eimco No. 21B air-operated loader. Empty cars are switched to the head of the train by an overhead, trolley-type cherry picker, each car to be spotted being lifted from the track by a compressed-air cylinder and pushed by hand into a recess in the side wall while the car just loaded at the breast is hauled back beyond it. These stations are cut once a week, on Sunday, when normal operations are shut down. A siding for the drill carriage was excavated when the new work was started, and another one was put some 3000 feet ahead, at approximately the halfway mark.

A full drilling crew is made up of thirteen men, and the drilling time averages 1 hour and 40 minutes. Loading and blasting takes 30 minutes, and is followed by a 15-minute period of exhausting air from the heading. Then mucking starts, and requires 1 hour and 10 minutes. The total cycle per round thus runs about 3 hours and 35 minutes. Owing to a shortage of labor, work was conducted on a 2-shift basis from the beginning of operations on July 13, 1943, until last November, when a 3-shift schedule was adopted. The average progress per shift has been around 14 feet. Drilling crews participate in a bonus paid for any advance in excess of 10 feet a shift.

Electric-storage-battery locomotives of Jeffrey, Atlas, and Goodman makes handle all but main-line haulage. Track is of 24-inch gauge and of 30-foot rails, except near the heading, where 6-foot lengths are laid. In advancing into the muck pile, U-shaped rails, made by welding together two 3-inch angle irons, are slipped over the regular rails and can be quickly slid ahead as mucking proceeds. Ventilating air is conducted into the tunnel through an 18-inch sheet-iron pipe that served the Carlton Tunnel, a blower stationed in the compressor house delivering up to 7000 cfm. The piping arrangement at the blower end is such that the direction of flow can be reversed by operating valves. Low-pressure relief valves guard against the possibility of the line collapsing in case of stoppage while under suction. Air is blown into the tunnel except immediately after a blast, when it is exhausted. A conically shaped shield that is connected to the delivery end of the pipe by a cage of small iron bars protects the line from flying rocks during shooting.

When work began, water was flowing from the tunnel at the rate of approximately 1200 gpm. Since then, additional seepage from fault planes has increased the volume to around 3000 gpm. Most of this water comes out of the ground at a temperature of 37°F., or only 5° above freezing. As a result, the tunnel is unusually cold, ranging from 42 to 44° at the heading. A ditch 2 feet wide and 1 foot deep is cut at one side of the bore to handle the flow. Air-operated sump pumps are used to clear the heading of accumulated water. For a period of several weeks after the flow of cold water was encountered, electric heaters were set up at the heading for the comfort of the crews. However, as the bore is being extended, the temperature is gradually rising and workers now rely on heavy clothing alone to keep warm. The severe conditions have resulted in a high frequency rate of colds and added to the problems incidental to carrying on operations in the face of the prevailing labor shortage.



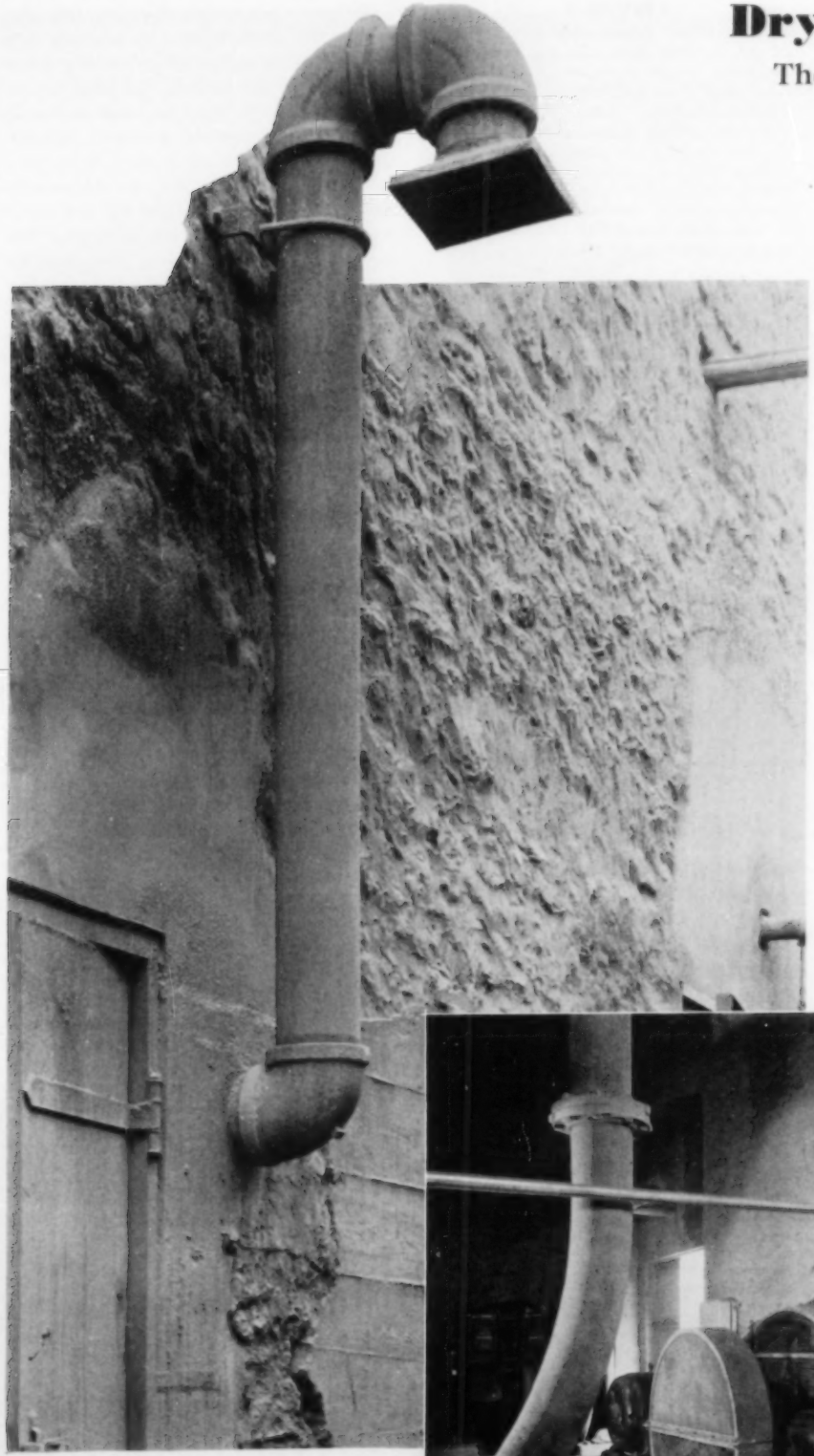
RECONDITIONING DRILL STEEL

From 800 to 1000 detachable bits are hot-milled (right) each day shift and are hardened at night on an 8-place quenching fixture. Shanks are forged on Jackrods in an I-R sharpener (left).

Dry-Type Air Filters

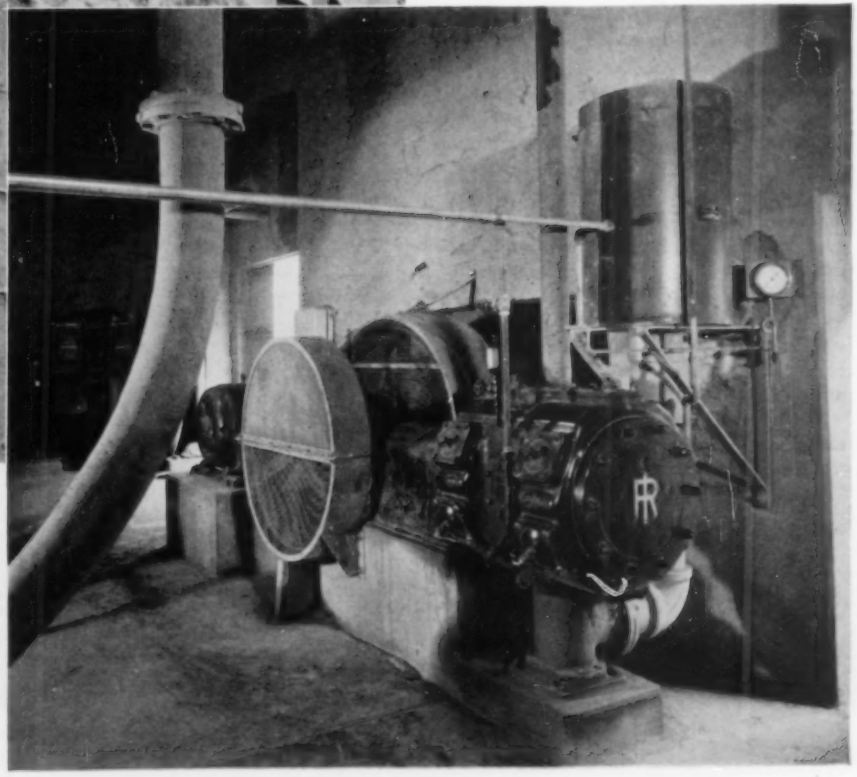
Their Selection, Installation, and Maintenance

J. S. Zahniser



DUST and taxes are ever with us. Taxes are of two kinds, direct and hidden. Hidden taxes attract less attention than direct ones, although they are more costly. Dust damage presents a parallel case; in fact, it is the worst kind of taxation because no possible benefit can be derived from it.

The average dust load in "clean" outdoor air varies with the neighborhood, but is usually sufficiently heavy to interfere with the operation of certain machines unless proper measures are taken to protect them against the abrasive action of the myriad air-borne particles. This is especially important in the case of internal-combustion engines and compressors designed for high speeds and with extremely close tolerances. To make this plain, let us take a compressor with a capacity of only 100 cfm. located in an average industrial district and provided with an unfiltered outdoor intake. It has been computed that each minute the machine is in operation there is drawn into it at least 1,200,000,000 particles of dust and carbon of which as high as 50 per cent may be large enough to cause appreciable abrasion. A sub-



CEMENT-MILL INSTALLATION

Because air is likely to carry an unusually large volume of abrasive dust, it is vitally important that compressors in cement-manufacturing plants be protected by efficient intake filters. Shown here (right) is a compressor served by an 1100-cfm. dry-type filter mounted indoors on a wall bracket for convenient servicing. The air intake (above) is located outside the building, is at a considerable height above the ground, and its downward-opening throat is protected by a screen.

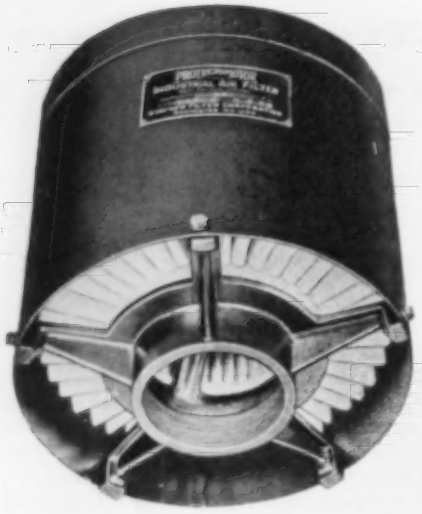


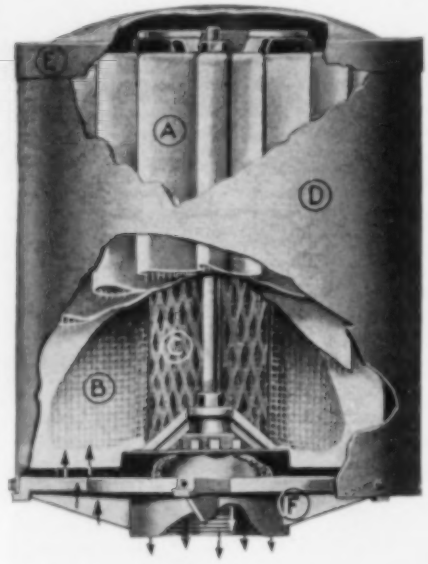
FIGURE 1

A cylindrical, heavy-duty compressor or engine filter with pulsation-resistant, radial-fin insert covered with Feltex and readily accessible for inspection by removing the cover. The cutaway view shows the internal construction: *A*, filter medium; *B*, rust-resistant wire-screen fin; *C*, rigid expanded-steel reinforcing outlet core; *D*, circular steel housing; *E*, removable steel cover; *F*, semi-steel supporting base threaded for attachment to air intake.

stantial percentage of these remain inside, while the remainder passes on into the compressed-air system to cause further trouble.

It is the purpose of this article to describe the dry-type filter and to point out its function in helping to provide clean air for man and his machines. This type is the only one in which the inherent characteristics of the filtering medium itself are depended upon to remove the dust; it does not require an accessory filter aid in order to function properly. Nor does it, as is frequently supposed, depend primarily upon a sieving action. The pressure needed to force a gas through a filter with 50 per cent voids and with openings small enough to sieve out particles 1 micron (1/1000 mm.) in diameter has been calculated to be about 100 times as great as that required for an ordinary high-efficiency filter. Everyone has observed the tendency of dust to settle on solid surfaces. The principle upon which the most efficient type of air filter is based is the use of a multitude of minute obstacles placed in the path of the dust-laden air and offering a relatively large surface area. High-grade felt, other napped fabrics, or even loosely woven cloth meet this requirement. The individual fibers or threads are the obstacles around which the air must pass, and they provide the surface on which the dust is deposited.

Naturally, the deposition of dust is aided if the air is passed over the individual fibers at low velocity. It is therefore customary to slow down the



flow through the filter medium itself by providing the maximum possible surface area. The method employed to accomplish this without enlarging the face area is by crimping the medium on to a suitable support in the form of a continuous V, with the fin edges perpendicular to the direction of flow. In addition to increasing the area, this also causes the air to strike the medium at a very oblique angle, thus placing more obstacles in the path of the dust.

For service in pipe lines and on air intakes of compressors, blowers, and engines, the accordion-pleated filter may be in the form of a radially finned cylinder. This construction not only provides a large area in a small space but also a mechanically rigid unit that resists flow pulsations and is suitable for pressure and vacuum work. The type of filter required is determined largely by the applications, which will be divided into the following three classifications to facilitate selection:

1—Air intakes of compressors, internal-combustion engines, etc., where relatively high filter resistance, up to 1.5 inches of water, is permissible. In this service the filter is subjected to very severe pulsations and must be heavily constructed to stand up and perform satisfactorily. Cylindrical filters or combination silencer-filters, as shown in Figure 1, are most commonly used because their shape and the radially finned filter element or insert present no flat surfaces to pulsating air flow. High filtering efficiency is essential, and the filter media should be such as to withstand many cleanings and washings.

2—Blowers and ventilation systems where medium filter resistance, up to 0.5 inches of water, is permissible. In this service the air flow is nonpulsating, and panel-type filters (Figure 2) are ordinarily used. This type, when fitted with corrugated or finned filter media, offers a large filtering area in the form of a flat or V-bank installation, permitting the handling of comparatively large volumes of air in a minimum of space. The efficiency requirements for these applications vary with the individual installation and call for careful analysis before selecting the equipment. Generally speaking, the more efficient the filter, the higher its resistance to air flow, and, therefore, the higher the fan pressure required. The con-

FIGURE 2

This filter is designed for use with blowers and with ventilating systems for public buildings. The filter element is housed in a steel frame and is protected on both sides by a rust-resisting wire screen that reduces the danger of combustion when exposed to flame. To obtain uniform air flow through the unit the fins are kept evenly separated by means of spacing bars. A 2-bladed vacuum attachment (left) that fits over a fin permits cleaning the filter while in service.

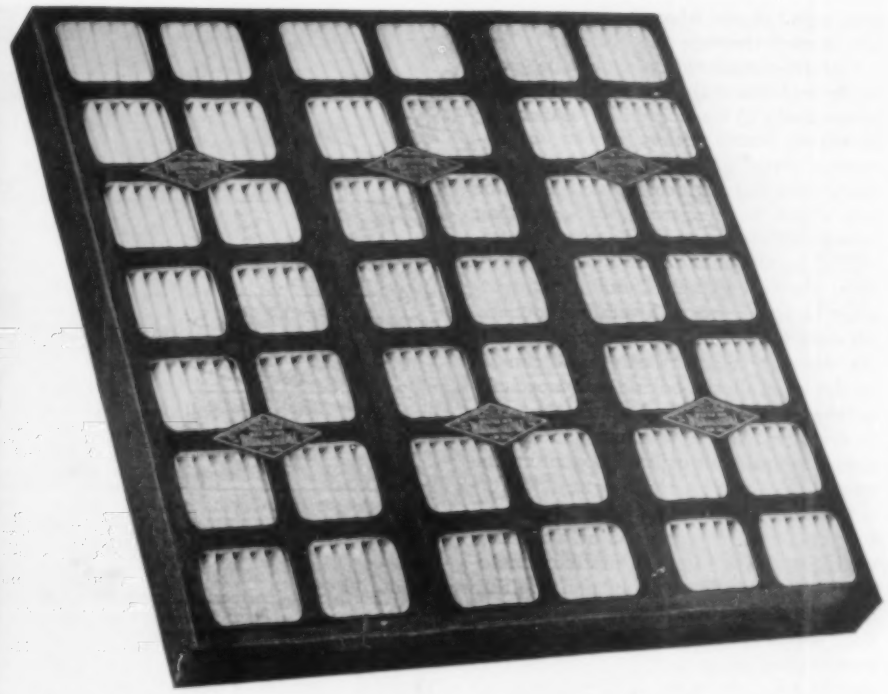


FIGURE 3

This filter is designed for use with warm-air furnaces, unit ventilators, and the like, where dust loads are light and the air flow is nonpulsating. For this service a light-metal or fiberboard panel-type construction with low filtering resistance is adequate. At the left is shown a multiple-V arrangement of panels for a 15,000-cfm. installation of this type. The view also illustrates how panels may be cleaned with a portable vacuum outfit.

verse does not necessarily follow; that is, that filters having a high resistance are most efficient. Grade of material, filter area, and air velocity all have a bearing on the matter.

3—Warm-air furnaces, unit ventilators, etc., where low filter resistance, up to 0.2 inches of water, is permissible. Here the air flow is nonpulsating, and a light-metal or fiberboard panel-type construction, Figure 3, can be used. These filters, because of their lower resistance and low-cost design, are generally less efficient than those for the larger central ventilating units. But inasmuch as comparatively light dust loads are encountered in these services, there is no justification for the use of the more efficient, cleanable, higher-priced filters. For this reason many cells with cheap media are utilized. These are not easy to clean and are termed "throw-away" types. They must be replaced once or twice a year, depending upon conditions. However, there is now available a cleanable, relatively inexpensive cell that embodies the Multi-V or finned insert and is covered with a medium of higher than ordinary efficiency. This has an average life of about three years and is becoming increasingly popular.

To assist potential purchasers in choosing dry filters with proper filtering areas for specific jobs, a selection chart, Figure 4, is provided. To determine the proper percentage to be derated from a given maximum filter rating, take the zone in the chart that has a listing comparable to your operating conditions and make a choice from the curve within that zone. For example, an industrial district in which there is a moderate dust load and where the filter is to be operated up to 24 hours a day would fall in Zone 2, which represents an average or intermediate condition. Referring to the curve, you would select a filter derated to about 68 per cent of the maximum rating; that is, a compressor with a displacement of 100 cfm. would require a filter having a maximum rating of at least 147 cfm. By reason of the fact that the dry-type filter does not depend upon any closely maintained or fixed air velocity to operate efficiently, an oversized unit can be chosen. This will obviate the need of frequent servicing even under the most severe conditions.

For best results, compressor, engine, and blower intake filters should be installed out of doors, preferably on the coolest side of the building. The intake pipe or duct should be extended upward so that the filter will be several feet above ground level, or above any flat surface where dirt might collect. Care should be taken that it is some distance from steam, water, or other exhaust pipes. If these directions are followed, the compressor, engine, or blower will give maximum performance while imposing a minimum load on the filter, thus assuring long life and infrequent servicing and cleaning.

Filters in ventilating systems are frequently called upon to handle large volumes of air. Because they are of the panel type and are normally installed in a flat bank or series of V's they may occupy a relatively large area. Care should therefore be taken in designing the duct leading to the filter bank so that the air flow will be evenly distributed over its entire surface. Where a duct is needed ahead of the filter, a straight run of some length should immediately precede the filter bank. Filters will perform equally well whether placed before or after the circulating fan. However, they are usually installed ahead of it, or on the suction side, because the duct size at that point is generally larger and better adapted for a filter bank. For the same reason air velocities are lower, thus helping to distribute the air evenly throughout the cells.

Dry-type filters do not call for the use of a preheater because they require no oil or other viscous coating and performance is in no way affected by low-temperature operation. On that account they can also withstand reasonably high temperatures that would cause films of oil to evaporate rapidly. Thus the heating and cooling coils can be located on either side of the filter bank, whichever is most convenient. Generally, however, they are installed on the back or clean side. This is of aid in maintaining their heat-transfer efficiency because it prevents the formation of a coat of dust on the coils. The dry filter is suitable for handling a mixture of fresh and recirculated air and serves especially well in department stores and fabric

processing plants where heavy lint loads are carried through the system.

Careful consideration should be given to the location of the fresh-air intake and particularly to the possibility of drawing in odors, fumes, heavy smoke, or excessive dust. It should be kept well away from flat surfaces, ground level, or pits which form natural dust-collecting basins. Where possible, it should be installed on the side of the building away from prevailing winds, and should always be protected with weather louvers. All duct work should be designed so that the interior is as smooth as it can be made; leaks should be avoided especially between filters and fan because that area is under negative pressure; and draft gauges should be utilized to determine when filters require cleaning.

The dry filter should not be cleaned too often, for the precoat or dust load which builds up on the medium materially increases filtering efficiency. This is well illustrated in Figure 5. Performance curves show the relationship between total dust load to the filter, resistance to air flow, and filtering efficiency, which is the ratio between total dust fed and dust passed through the filter, as determined by the dust-spot or discoloration method used by the U.S. Bureau of Standards.

Accumulations of dry dust can be removed either by brushing the filter lightly or by tapping it, face down, sharply against the floor or other rigid surface. This gets rid of excess dust. What remains should be removed by an industrial-type vacuum cleaner that is capable of building up at least 40 inches of water pressure against a closed discharge.

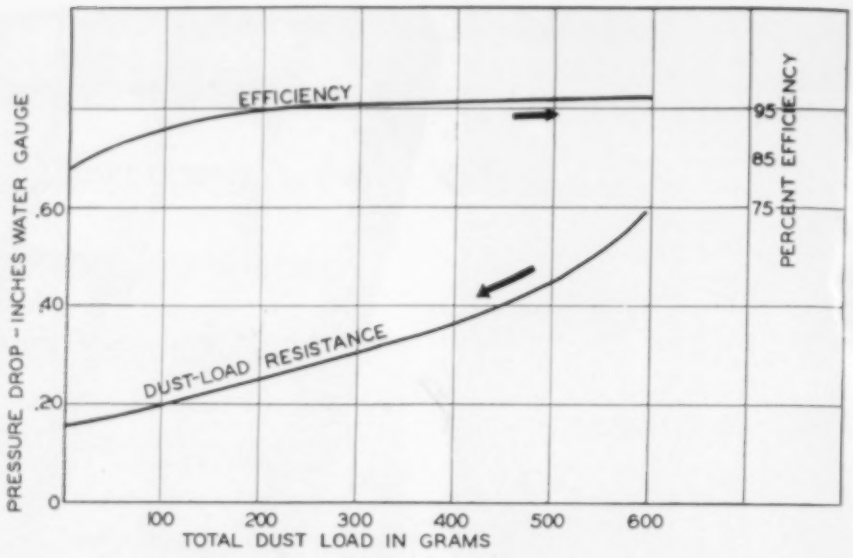


FIGURE 5

This is a typical performance curve for dry-type filters and shows the relationship between dust-load resistance and filtering efficiency.

There is available a special nozzle, as shown in Figure 2, formed to fit the contour of the filter face.

Vacuum cleaning does not completely restore the original filter resistance. A gradual building up of resistance will be noted, particularly in the case of "felted" materials. In time, this seriously affects air flow. Where greasy soots must be handled, the building up is more rapid than under ordinary circumstances. Resistance should be checked periodically, and when it is close to the allowable limit immediately after vacuum cleaning, then the filter cell or element should be washed. When this is done properly, the resistance of the filter will be restored—will be the same as it was when the unit was new and clean. A high-grade solvent or detergent, preferably of the nonvolatile type, should be used for this purpose. Washing is a simple operation; and it is recommended that all dry-type filters with felted, woven-wool, or cotton media be so treated at least once a year; oftener if they are exposed to greasy deposits. In the latter case, the work should be done as soon as possible after the element is removed from service to prevent drying out and caking of the accumulated deposits. Instructions as to the cleaning methods and fluids can be obtained from the maker.

Filters fitted with paper or glass fiber should not be washed. However, in some of them the media are supported and protected by placing them between layers of metallic-screen cloth—a construction that permits them to be vacuum-cleaned. Dry-type filters should not be used where they will be subjected to vapors from vegetable oils that oxidize readily in air.

Compressed air may be employed as a cleaning agent, but extreme care must be exercised and pressures higher than 20 to 25 pounds should never be used. Furthermore, the blast from the nozzle should never be directed against the flat surface of the material because it might blast the felted fibers apart, thus leaving in the felt thin, open areas through which the air would tend to by-pass at high velocity and possibly carry along with it relatively large dust particles. The air stream should be directed at a very flat angle toward the cloth surface and should be applied from the clean side so that the dust is gradually forced to the outer surface of the material.

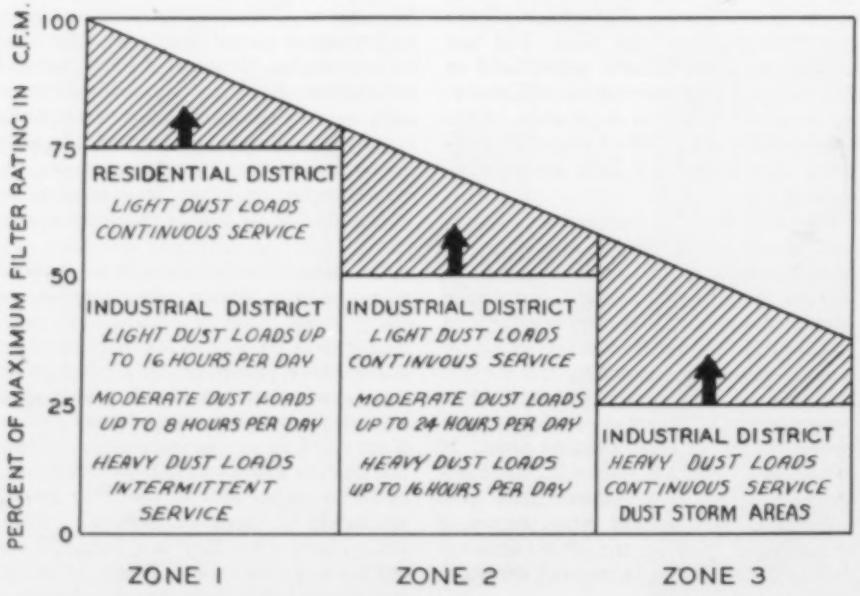


FIGURE 4

This selection chart for dry-type filters is applicable to filters for intakes of compressors, blowers, and internal-combustion engines. It shows the percentage by which a given maximum filter rating should be reduced to meet a given set of conditions. The method of determining the filtering area required is explained in the accompanying text.

Cast-Off Hosiery Helps Wage War

S. G. Roberts

U. S. Navy Photos

ONCE THEY WORE 'EM, NOW THEY RIG 'EM

These pictures show girls handling parachutes made from reclaimed hosiery. The two seamen at the top are "whipping the canopy" in a parachute loft at a U.S. naval station. The girl just above is checking parachutes in a dry locker—part of the work that will enable her to attain a rating of parachute rigger.

AMERICAN women have been asked to forego silk and nylon stockings and to give the Government all such hosiery that has been laid aside because of "runs" or other defects. Willing as our women no doubt are to contribute in this manner, they, as well as other persons, may wonder how the adoption of stockings of other fabrics can help our fighting men to battle more effectively with our foes. For the answer we must go back nearly 40 years to a naval disaster that cost the lives of 31 men.

The old U.S. Battleship *Missouri*, on April 13, 1904, was at target practice off Pensacola, Fla. The crew in the after main turret was loading the left 12-inch rifle, which had already been fired thirteen times. The projectile had been rammed into place in the breech, and the first of two 550-pound bags of smokeless powder had just been shoved in behind it when that bag became ignited by the hot gases and smoldering bits of powder bags remaining from the previous shot. The inflamed bag instantly set fire to the second one resting on an ammunition car close to the open breech of the gun, with the result that the turret, the handling room, and intervening spaces were filled with suffocating burning gases, causing the loss of life mentioned. Compared with black powder, smokeless powder is not flashy, and the burning grains first dropped to the floor of the turret. Then some of them fell down the shaft that connected with the handling room directly beneath the turret, and from there others continued on to the deck below on which the magazines were located! The prompt action

WHERE SILK IS A LETHAL WEAPON

A lighter delivering a load of 14-inch projectiles and tanks of smokeless powder to a battleship. The powder in each tank is encased in a bag made of silk fiber.

of Mons Monssen, a warrant officer, probably saved the *Missouri* and all her personnel from destruction.

Monssen quickly stepped into one of the magazines, closed the door behind him, and admitted water to both magazines to protect them against the menace of heat and flame just outside. He did not leave the partly water-filled compartment until all danger of fire was passed. Monssen was awarded the Congressional Medal of Honor on March 3, 1915, for his extraordinary heroism and distinguished conduct and, about five years later, was promoted to the rank of lieutenant in the line of the Navy.

Prior to that disaster, smokeless powder was packed in bags of bunting—the same thin woolen material that has been used for many years for all naval flags. An investigation disclosed that in addition to the high-temperature gases lingering in the bore of a large gun after firing there were likely to be smoldering bits of bunting. At target practice, several shots are fired in rapid succession during a run past a target—simulating to a degree conditions in actual battle. After considerable research, naval experts discovered that a fabric of natural silk was far superior to bunting because it would be consumed well-nigh instantly by the powder flames; and bags of raw silk have been in use ever since in our battle fleet. As a further safeguard against "flarebacks" the Navy devised means for discharging a strong blast of compressed air into the bore at the breech of a gun immediately after firing and before opening the breech. This clears the weapon of hot gases and any residue from the inflamed powder bags.

This bit of history makes clear in a measure why silk is, indeed, a critical war material. No raw silk is produced in America, and, of course, war in the Pacific makes importation impossible. Before Pearl Harbor, America was the world's greatest buyer of silk from Japan —the largest producer. About 90 per cent of all that silk was utilized to make women's stockings; and these are still our highest potential source for silk reclamation. Approximately fifteen pairs of stockings provide sufficient material to make one average-size powder bag. Silk has also been widely used in the making of parachutes.

Nylon likewise is a vital war material, and its function in national defense is nearly as important as that of silk. Although nylon is a product of chemistry—created from coal, air, and water, the process is a complicated one that calls for the use of high-pressure equipment that is now being utilized to maximum capacity. To build more machinery for the manufacturer of nylon would require not only a great deal of material but also much manpower—neither of which can be spared today. Something like 90 per cent of all nylon produced prior to Pearl Harbor went into stockings. By a method of reclamation it is possible to reduce the nylon in stockings to a state that permits both reworking and reconverting it at a considerable saving in time.

The strength, lightness, elasticity, durability, and adaptability of nylon fits it for many essential wartime services. It serves, for instance, to make parachutes and parts such as tapes, shroud lines, harness webbing, belting, etc. Some of these parachutes are used for dropping ground flares around an area to be attacked; others for slowing up the fall of delayed-action bombs that are dropped from relatively low altitudes so as to give the bombers time to get away. Then there is nylon rope for glider take-offs as well as tow lines.

Because silk and nylon are suitable for these military purposes, the Government desires stockings made of these fabrics, as well as of mixtures of silk and nylon, silk and rayon, silk and cotton, nylon and rayon, or mixtures of nylon and cotton. Runs, pulls, or holes do not matter, because the methods of processing are such as to fully reclaim the silk or nylon content.

When women leave their washed hose in any of the Stocking Salvage Depots located in the thousands of hosiery stores throughout America, the retailers pack and ship them to the Defense Supplies Corporation, Green Island, N.Y., and that government receiving depot sends them on to the proper places for reconversion. The hose first pass through a special dye bath. All sorts and varieties are thrown into the huge vat where each stocking takes on an identifying color according to its particular material. Silk shows up one hue, nylon another, and mixtures still another. This makes preparatory assorting comparatively simple. After drying, those containing silk and nylon are separated and all the unwanted pairs of cotton and rayon are discarded.

The silk stockings are then ready to go through what are known as garnetting machines which break down the fabric to a fibrous state. These filaments are bleached and once again worked into threads from which are woven a coarse, sturdy fabric that somewhat resembles a cross between burlap and closely woven homespun. This material is used exclusively for powder bags, both for the Navy's and the Army's big guns.

Nylon hose, when chemically treated, can be reduced to the same gummy substance it was before being spun into filaments for the original thread. This sticky mass is processed by putting it through a sievelike apparatus, called a spinnerette, which forms the threads that can be woven into strong nylon fabrics or other vitally necessary war products. The reclamation described is applied exclusively to women's hosiery because less than 1 per cent of the socks worn by men and children do not contain enough silk and nylon to make recovery worth while. Accordingly, such hosiery, as well as the small percentage of other articles made of pure silk or nylon, are not sought by the Government for reuse. The authorities say: "Save them for the rag bag." In the parlance of the broadcaster: Women, it is up to you! Keep your feet on the ground but your stockings in the air!

Freeze It, Then Eat It

FREEZING outfits that will enable families to preserve all sorts of fresh foods for subsequent consumption are envisioned for home use in the postwar era. The equipment will be of various types and sizes. There will be units suitable for apartments, others for small houses, and still others for people living in the country. Under mass-production methods an outfit for a large family will cost no more than an automobile, and the operating expense will be far less. Some owners will raise their own produce, while others will purchase what they freeze at roadside stands or in stores.

Instead of making frequent time-consuming shopping trips for food, the future housewife will simply withdraw from cold storage whatever she needs for the day. She will be able to buy in quantity and at the height of the growing season when quality is high and prices are low. No longer will she be dependent upon shipped-in fruits and vegetables during the off season. Quality will be better because each item will be frozen while fresh when it has its full nutritive content.

A typical freezing system for a family home may consist of three units: a quick freezer, a cool room, and a zero room. The quick freezer is a cabinet resembling that in which ice cream for soda fountains is kept. It has one or more cylindrical compartments or wells with insulated covers, and a built-in compressor of the mechanical refrigerator type maintains a temperature of from zero to −10°F. for quick freezing. After the food has been frozen it is transferred to the zero room which, together with the adjoining cool room, has thick insulated walls. Entrance to the former is gained by way of the cool room, which is maintained at around 40° by blowing air over cooling coils and in which are stored such foods as milk, cream, eggs, and meats that are to be kept cool but not frozen. From there a heavy door opens into the zero room. This is the place where everything that is frozen solid is stored. The coils through which the refrigerant circulates may be used as shelves. The two rooms are served by a second and larger compressor the operation of which is controlled automatically by a thermostat switch. This starts the machine whenever the temperature in the zero room rises to a given point.

There may be many variations of this arrangement, depending upon a family's needs and the space available. By making the quick-freezing cabinet large it can serve also as a storage unit. The cool room, which replaces the conventional refrigerator, may be dispensed with if the latter is retained. Large apartment houses may have community cold rooms with lockers for each tenant. Likewise a group of home owners in one neighborhood may establish a centrally located freezing plant and cold lockers such as are already in use.

Silver Dollars Stay

OUT in the West they are staging a minor revolution against a proposal to withdraw silver dollars from circulation. Although staid Easterners, who not only prefer "folding" money but insist upon getting it, will find this difficult to understand. Nevertheless it is a real and definite protest. When a Westerner shoves a hand into his pants pocket he likes to hear the jingle of silver. It is a comforting sound that he can't get from rubbing a couple of bills together. He'll take bank notes where large sums are concerned, but he doesn't feel completely dressed unless he has a few silver dollars in his jeans to fondle.

If you change a $5 bill anywhere west of Chicago you are likely to get back some silver dollars. In Denver the average will be two, while in Butte you are almost certain to get five cartwheels. That Montana metropolis owes its ascendancy to copper rather than to silver, but it started out as a silver camp and has always used silver currency. When a Montanan invades the East on a business or pleasure trip, he carries along a few silver dollars as a matter of course and sees nothing unusual in that fact. The only thing he can't understand is why tradesmen along the Atlantic seaboard look askance upon good coin of the realm that rings so pleasantly.

A Butte man who has plenty of this world's goods became indignant last winter when a stiff-collared hotel clerk in a swanky Gotham hotel cast suspicious looks at a silver dollar that was tendered him and asked, "What is that?" To make matters worse, he put the accent on "that," and the citizen from Butte says he spoke with an English accent to boot. As it is distasteful to any Westerner to have the validity of a silver dollar questioned, it need hardly be added that the man from Butte gave the clerk an icy stare and "told him off" in no uncertain terms.

A few weeks ago the managing director of the Federal reserve bank in Montana threw a verbal bombshell into the state by announcing that the supply of silver dollars in circulation there would be reduced and that bills would eventually be substituted for them. The reason given was that the men employees have been largely replaced by women who find the shipments of dollars too heavy to handle. Although chivalrous enough to sympathize with the women, Montanans vowed that they wouldn't be weaned away from silver dollars.

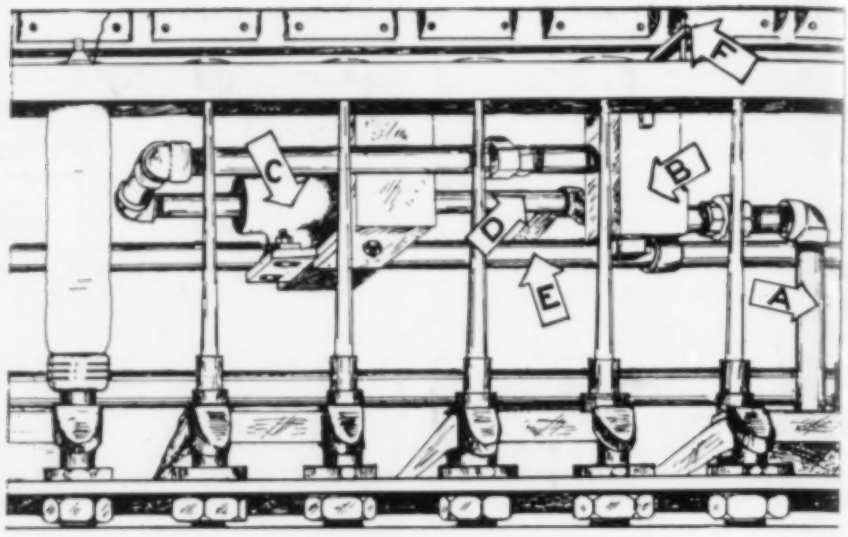
At last reports, the cheerily jingling cartwheels were as numerous as ever in Butte and elsewhere in the West. As a matter of fact, mint officials say the circulation of silver dollars in the nation is increasing, having risen from 69,000,000 to 89,000,000 in the year ended last August. Virtually all of them are in the West, but Easterners use a few for Christmas gifts now that they can't get gold. No silver dollars have been minted since 1935, chiefly because they aren't needed. The available supply totals 343,606,000, or about eleven for each inhabitant of the western states.

Pneumatic Stop for Spinning Frames

SPINNING and twisting machines, regardless of the type of drive, can be equipped with an automatic stop that is said to be really satisfactory, something that has heretofore been lacking. The O. B. Pneumatic Stop Motion, as it is designated, has had more than two years of service in several large textile mills in the Carolinas and in that time has proved its practicability, it is claimed.

All textile spinning frames have a control or shipper rod that runs the length of the frame. When this rod is shifted it stops the frame either by throwing a belt on to a loose pulley or, in the case of direct motor drive, by opening a switch. Under the new arrangement the rod is attached to the piston of an air cylinder. When the ring reel or traveling trip on the frame actuates an air valve, compressed air is admitted into the cylinder, thus moving the piston and shifting the rod which, in turn, throws the belt or operates the switch, as the case may be.

The automatic stop relieves the operator of the responsibility of watching and knocking off frames when ready to doff—to remove work—as it can be set to wind bobbins of any predetermined size; prevents overrunning bobbins, which means waste; saves time during weaving in sloughing overrun bobbins; and generally makes for better-quality thread and increased production.



AIR-CONTROLLED STOP

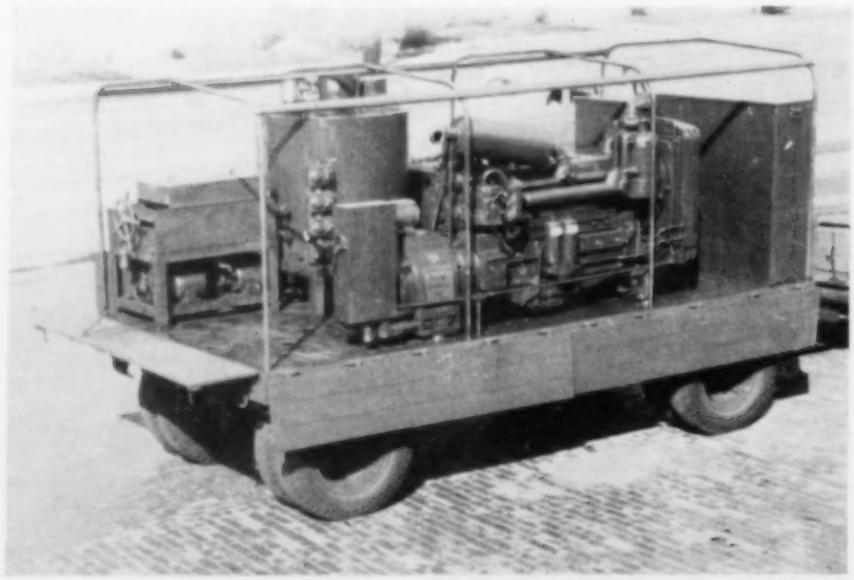
Longitudinal section of part of a spinning frame showing the new automatic stopping mechanism. *A*, ⅜-inch air inlet; *B*, air valve; *C*, pneumatic cylinder; *D*, piston; *E*, shipper rod; *F*, air-valve trip.

Mobile Oil-Reclaiming Plant Goes to War

THE conservation and transportation of lubricating oil at the front is a vital problem, and to keep automotive equipment rolling the Youngstown Miller Company has designed, built, and delivered to the Marine Corps a mobile reclaimer for use back of the lines. Mounted on a trailer is a standard type Y-M reclaimer, a diesel-electric generating set, a clean-oil storage tank, a fuel-oil tank, and waterproof storage bins for refinery earths, filter papers, and spares.

In operation, a charging pump conveys the dirty oil from drums on the ground to the heating tank, where it is brought in intimate contact with refinery earth at sufficient temperature to dissipate the volatiles. Heating is controlled by thermostats. When the proper temperature is reached, the oil drops into a transfer tank from which it is forced by compressed air through a 2-stage filter unit and into the clean-oil receiving drum.

The reclaimer is designed for the purification of dirty lubricating oils from diesel, automotive and aircraft engines, as well as hydraulic, vacuum pump, and transformer oils. The restored lubricants are said to have substantially the same fire, flash, viscosity, color, and other values as the parent oil.



GOES IN DIRTY—COMES OUT CLEAN

This unit serves back of the lines and makes dirty lubricating and transformer oils fit for reuse. It is of the contact earth-filtration type and is built in eight sizes to meet a wide range of requirements.

Lightweight Railway Axles

RAILWAY-CAR axles of seamless tubing are being produced in a plant recently put in operation by the Pittsburgh Steel Company. This pronouncement must be qualified to fully appreciate the significance of the change. Size for size, a solid axle with 5x9-inch journals weighs 177 pounds more than a tubular one, while an axle with 6½x12-inch journals is 510 pounds heavier. In the case of a 4-axle car this means a weight reduction of 708 to 2040 pounds. The plant has a capacity of 500 a day. According to *Steel*, the exterior surface of the new axle is straight between wheel seats instead of tapered toward the center, as is the solid axle. Its walls are thickest at the journals, slightly thinner at the wheel seats, and thinnest between the seats. This distribution of the metal gives the axle adequate strength where needed and permits a saving in weight of 25 to 43 per cent.

Will Receive Annual "Moles" Awards

ARTHUR A. JOHNSON

GENERAL SOMERVELL

Lieut. Gen. Brehon B. Somervell, Chief of the Army Service Forces, and Arthur A. Johnson, New York contractor, will receive awards "for outstanding contributions to construction progress" on February 2 at the annual presentation meeting of The Moles, New York organization of tunnel and heavy-construction men. As head of an Army branch that builds airfields, training centers, and every type of structure needed to service the fighting forces, General Somervell has directed the largest construction program ever carried out by any man within so short a period. He commands one-fourth of our soldiers and employs nearly 1,000,000 civilians. Mr. Johnson, who will receive the member award, is vice-president of The Moles and has been building subways, tunnels, and other engineering works for 35 years. In preparing the site of the New York World's Fair in eight months, he moved 7,000,000 cubic yards of earth. Among other jobs that he has handled were the East River tunnels for the Pennsylvania Railroad, and a unique scheme of moving back the boardwalk at Coney Island. He has recently been engaged on war contracts, including the building of a $9,000,000 arsenal in 200 days.

Low-Tin Solder and Babbitt Alloys

MORE than 850,000 pounds of tin has been saved by the General Electric Company since Pearl Harbor as a result of changes in solders and babbitt alloys imposed by the need of conserving our supplies of that strategic metal. Calculated in terms of No. 2 food cans, which are tin-plated on both sides, this means enough for about 825,000,000 such cans. Before the tin content in solder for ordinary work was limited by the WPB to a maximum of 30 per cent in 1942, and finally to 20 per cent in 1943, most of the solders were made of half tin and half lead.

Of the series of solders developed by the General Electric Company, that for the general run of purposes contains 20 per cent tin, 1.25 per cent silver, 1.5 per cent antimony, and lead. This is said to be the most popular one in use today. It comes in wire form, both solid and rosin-cored, for all kinds of electrical connections that were formerly made with solders ranging from 40 per cent tin and 60 per cent lead to 60 per cent tin and 40 per cent lead. About the only change in technique required is the utilization of a hotter soldering iron because solder with 40 per cent tin melts at 455°F. and with 20 per cent at 518°. Depending upon the service, low-tin solder can be used with rosin or other noncorrosive fluxes, or with corrosive fluxes such as zinc-chloride. Its rupture strength at high temperatures is better than that of 40-50 per cent tin-lead solder.

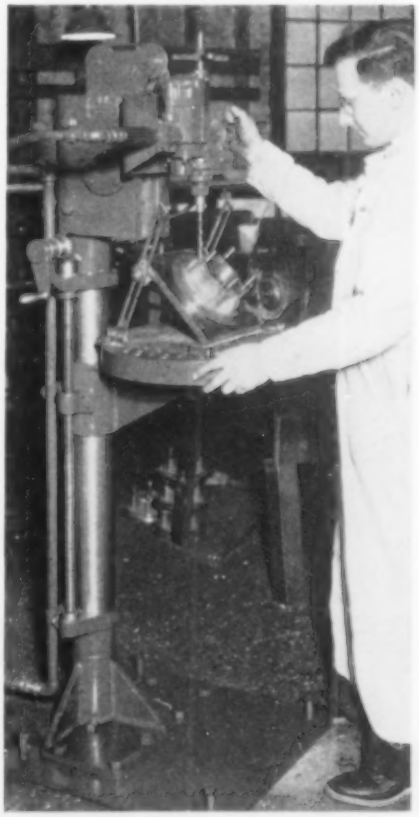
Babbitt alloys for lining bearings contained 83⅓ per cent tin and 8⅓ per cent each of copper and antimony before the WPB order went into effect limiting the tin content for most purposes to 12 per cent. Except for large turbogenerator sets, guide and thrust bearings for vertical water-wheel generators, and for implements of war for which high-percentage-tin-babbitt bearings are specified, the General Electric Company uses an alloy containing 15 per cent antimony, 1 per cent arsenic, 0.5 per cent copper, 82.5 per cent lead, and only 1 per cent tin. The substitution of lead-base for tin-base babbitt has called for no change in bearing design, and the pressure or unit load carried is said to be the same in both cases.

Portable Drill Press

THE accompanying illustration shows how an air drill has been adapted to do much work other than that for which such a tool is normally used. Although designed to be held by hand, this Ingersoll-Rand 3SJ drill was mounted on a fabricated base and column and thus converted into a portable, vertical drill press. The machine is counterbalanced, the weight being housed in the vertical column. Vertical feed motion is controlled through a rack and pinion. The worktable may be adjusted vertically by means of a screw and swung around to any position, where it can be held by a locking device under the working surface.

The machine is in use in an eastern shipyard and has become popular on the shipways and engine-erection floor because of its portability. Small pieces such as clamps, brackets, and shims may be drilled near their places of application, thereby saving the time that would ordinarily be consumed in taking them back to the shop for drilling. It has been employed as a permanent drill press in the fabricating, boiler, electrical, sheet-metal, pipe, and maintenance shops, among others.

Aside from portability, the machine has the advantage that it can be used out of doors without the driving motor and operating parts suffering any ill effects. As to economy, practically no maintenance other than regular lubrication has been required. The machine has a drilling capacity of 1 inch, which is ample for the average work that has to be done in connection with assembly or erection jobs.



THE DRILL AT WORK

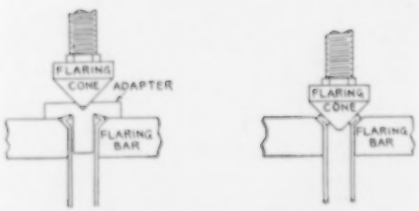
The worktable is adjustable through a wide vertical range that permits handling work of various sizes. The operator has his right hand on the drill-feed control. Air is introduced at the bottom and reaches the drill through a pipe and hose connection.

Industrial Notes

Increased production and uniform riveting are obtained, it is claimed, by a "rivet robot" developed by Willys-Overland Motors, Inc. The device can be attached to any standard riveter and automatically controls the number of blows applied to each rivet.

It has been found that floors made of white instead of gray cement have light-reflecting properties that increase the light on the underside of work as much as 61 per cent and on vertical surfaces 20 per cent. This aid to visibility is taken advantage of in aircraft and other war plants.

A pipe-flaring tool that is complete in itself—suitable for use on the job—has been announced by The Imperial Brass Mfg. Co. The apparatus is designed for making 45° double flares on all popular sizes (3/16 to ½ inch outside diameter) of thin-walled, soft-steel tubing for S.A.E. and inverted-flare joints, as well as single or double flares on copper or aluminum tubing. Packed in a metal kit, the tool consists of a flaring cone or yoke, a flaring bar, and five adapters.



HOW TOOL WORKS

First the flaring cone is screwed down with the correct adapter in the tube (left) to give the latter a bell-shaped end. The cone is then backed off slightly to remove the adapter, after which it is again screwed down, making the double flare as seen in the right-hand drawing. For service in close quarters a ratchet wrench can be substituted for the rod handle. The photograph shows the tool assembled and in operation.

By means of the latter the tubing is first belled, and then the flaring cone is screwed down, as the accompanying diagrams show. Folding back the end gives a wall of double strength and thickness and prevents the tube from being split or cracked during the flaring operation. The tool can be used on seamless, butt-welded, or lap-seam-welded tubing.

Carbozite is a new waterproofing for packing boxes and crates made of unseasoned wood. It is applied with a high-pressure gun and is dry to the touch in half an hours, forming a coating that is said to retard drying out, shrinking, and warping of the lumber.

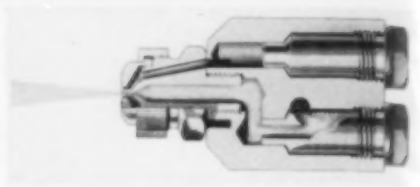
It is estimated that each man in our armed forces requires 4900 pounds of metal, as against 94 pounds in World War I. This is a tremendous increase, and may justify the fear expressed in some quarters that it won't be many years before some of our minerals will be exhausted.

Zinlac is a synthetic shellac that has been developed in the United States and is now being used exclusively for war purposes. It is said to possess the varied properties of the natural product, for which we have in the past relied mainly upon India.

Peacetime paint cans and metal smudge pots by which fruit growers shield their crops from frost have been combined to form a "smoke float" for the Navy. The new device makes use of a chemical instead of oil and works faster than the older smoke-screen method. The float is ready for action at a moment's notice and sinks when it has done its job.

What is announced as a "stripped-for-action" foundry show is to be held April 25-28 in Buffalo, N. Y., in conjunction with the annual meeting of the American Foundrymen's Association. The industry's wartime needs, practices, and developments are to be featured, and high lights will be off-the-record and open discussions on immediate production and postwar problems.

Many modern processes require control of atmospheric conditions, and for this service the Spraying System Company has developed an improved type of pneumatic atomizer. In this nozzle, water and compressed air are mixed to produce a round spray that is projected from 12 to 20 feet, depending upon the air pressure used in the humidifying system. The unit features two monel-metal strainers—one for air and the other for water—that prevent clogging of the orifice by pipe scale or other solids and can be easily removed for cleaning or replacement. The JHS, as it is designated, can be quickly adapted to nearly all types of installations.



George Scherr Company, Inc., has announced that it is producing 1-, 2-, and 3-inch Reed micrometers with graduations in tenths giving reading to ten-thousandths of an inch as easily as to thousandths. Freedom from glare and reflection is a feature of the thimble and vernier.

Even equipment on public exhibition is pressed into war service. In the Museum of Science and Industry in Chicago, Ill., there is a gray-iron foundry that attracts far more attention now than normally because it has a full-time job turning out much-needed small castings. It has been engaged in this work since April, 1943. The shop is enclosed in glass, and as visitors watch the operations they are explained by a guide using a loud-speaker system.

At a cost of $6 for a piece of second-hand tarpaulin, a contractor was able to finish a foundation job that gave trouble because of a heavy flow of water. Two cofferdams, one inside the other, and two pumps with a combined capacity of about 2200 gpm. proved unavailing, even though an area of only 7x30 feet was involved for the building of a gasoline station for the U.S. Coast Guard. The waterproof canvas saved the day. It was placed inside the inner cofferdam and was large enough also to line the walls of the enclosure. Concreting was started at the end farthest from the pumps, and as the material was placed, the water beneath the tarpaulin was forced toward a sump. A 1:2:3 mix was used, an extra bag of cement per cubic yard of concrete being added to counteract the effect of salt water that might penetrate the canvas.

Precision instruments like gauges, that are used to determine whether specified dimensions are kept within close limits or tolerances, have served their purpose as soon as they show the slightest wear. This results in high-gauging costs which can be offset, it is

reported, by means of Micronil that has recently been placed on the market by Protective Coatings, Inc. A little of the liquid is applied by brush to the leading edge and, to quote the maker, "lubricates in the surface rather than on it, preventing freezing and in some cases doubling gauge life." The preparation is also suitable for treating precision dies and punches and is applicable to all metals.

Huge underground reservoirs are being provided by the Navy in this country and at overseas bases for the storage of fuel oil. They are lined with concrete and, in the case of airplane gasoline and other light fuels, are given a coating of synthetic rubber. This is necessary to prevent leakage, a serious drop in octane rating, and the transformation of the gasoline into a sticky gum upon exposure to the alkaline present in the concrete. The rubber lining is applied with a special adhesive much like wallpaper.

Painting both sides of small washers used to be a tedious job in the plant of the Murray Corporation of America until one of the workers conceived the idea of spreading them out on a table with a screen instead of a solid top. By this simple expedient he can spray them top and bottom with his air gun without turning them over. This was done by hand and involved lots of time, as thousands of these washers are used in assembling airplane wings.

Magnesium metal, one of the critical war materials, is being recovered from tailings from the asbestos works in the Thetford region of Canada. An enormous stock pile has been built up there of platy particles that are not suitable for fibers or packing. This material is antigorite, a magnesium silicate compound, which is crushed, concentrated, and leached with dilute hydrochloric acid to form a magnesium-chloride solution which, in turn, is converted into magnesium metal by evaporation and electrolysis. Resultant by-products are salt cake, chlorine, chrome-nickel, iron oxide, and fine silica.

Airplane landing speeds up to about 200 miles an hour, which is considerably in excess of present speeds, are simulated by a machine built by the Goodyear Tire & Rubber Company for testing airplane wheels, tires, and brakes. The entire installation weighs more than 150,000 pounds, of which half represents a flywheel. This is operated by a 150-hp. motor and reaches top speed in 17½ minutes. A 40,000-pound apparatus is used to bring a tire against the wheel, thus duplicating the conditions to which it would be exposed in making an actual landing. A hundred and sixty-eight revolutions of the wheel are equivalent to one mile of travel, and the maximum test load totals 40,000 pounds, which is more than a tire, wheel, or brake has to withstand under present service conditions.

To offset the manpower loss that has caused a drop in the manufacture of vitally needed screw-machine products, the National Screw Machine Products Association has published a 107-page manual entitled, *On-the-Job Instruction of Screw Machine Personnel*. Operators of automatic screw machines come under the head of highly skilled workers, and it normally takes not less than two years to train a Class "A" operator and four years to turn out a set-up man. The manual is designed to expedite their training, to help companies using screw machines to give green hands a thorough knowledge of their operation by a point-by-point approach. All types of multiple-spindle automatics are covered and described in easily understandable language. Definitions and illustrations of key parts are included, as well as information on grinding and setting tools, trouble charts, etc. The book has a flexible, oil-resistant cover, is ring bound, and can be obtained for $2 from the National Screw Machine Products Association, 13210 Shaker Square, Cleveland 20, Ohio.

VITAL IN WAR
ESSENTIAL IN PEACE

No Other Light-Weight Pipe
Can Match NAYLOR Performance

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- SAVES MONEY
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Advantages like these have made Naylor the outstanding pipe for high and low pressure air and water lines in mining service. Sizes from 4" to 30" in diameter with all types of fittings and connections.

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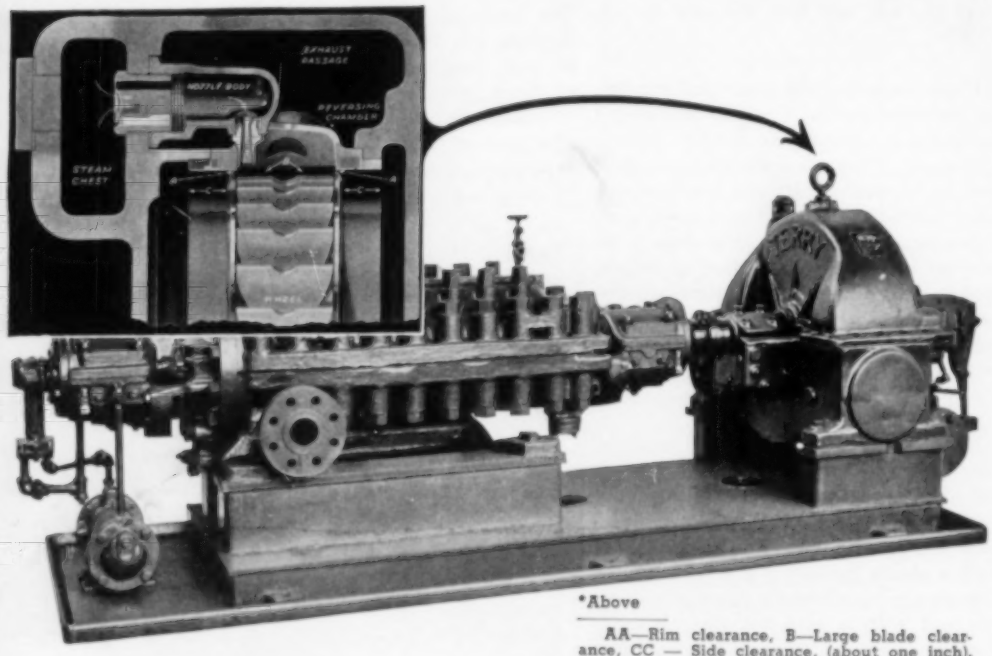

*Above

AA—Rim clearance, B—Large blade clearance, CC — Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.

END PLAY WILL NOT DAMAGE THE BLADING OF THE TERRY WHEEL TURBINE

In the Terry Wheel Turbine the blades are protected by rims at the sides of the wheel, which would take without damage any rubbing that might occur if the clearance became reduced. With this construction it is impossible for the blades to foul and frequent inspection of the thrust bearing is not required to obtain safe and dependable operation.

The Terry Wheel Turbine is fully described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1133

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

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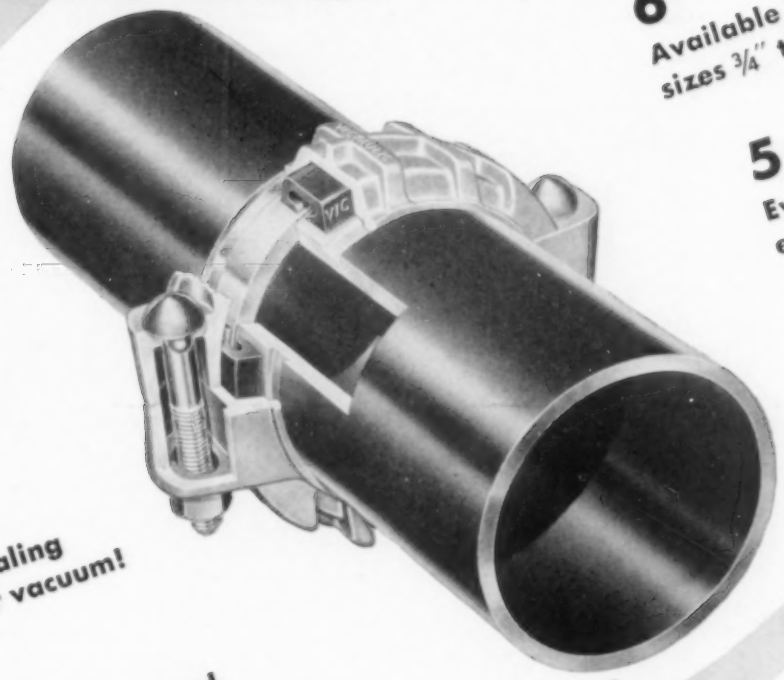

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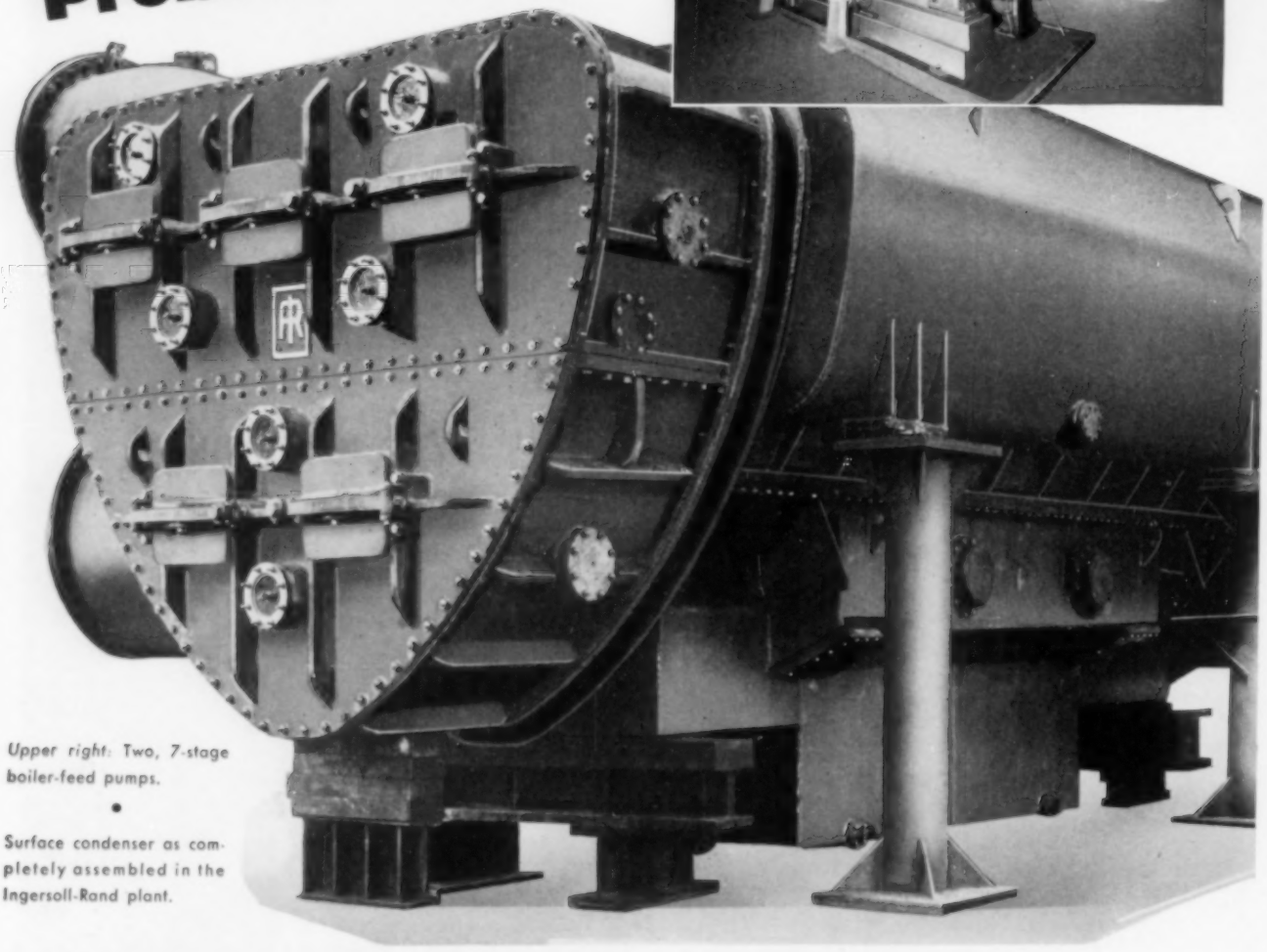
A TOUGH Problem Solved



Upper right: Two, 7-stage boiler-feed pumps.

•

Surface condenser as completely assembled in the Ingersoll-Rand plant.

Highly corrosive circulating water caused a large New England electric utility company to use jet condensers on their earlier installations. However, when a 40,000 KW extension was proposed, it was evident that a suitable surface condenser would have to be used to provide pure feed water for a modern 1350 psi. boiler.

The electric company and its consulting engineers conducted an extensive study in order to determine the best tube material. They consulted with Ingersoll-Rand regarding the design and construction of the condensing plant, particular attention being given to the water-box design, tube ends, and circulating pump construction.

This resulted in the selection of an Ingersoll-Rand 28,500 sq. ft. surface condenser with divided water boxes, two vertical circulating water pumps, and two condensate pumps.* It was a good selection as attested by more than 2 years of excellent performance under severe war-time peak loads.

This is an example of Ingersoll-Rand engineering service. May we help you? Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, N. Y.

**Other Ingersoll-Rand pumps in this extension include two boiler-feed units and twelve miscellaneous pumps.*

4-317

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES **Ingersoll-Rand** CONDENSERS • CENTRIFUGAL PUMPS

Now SEAL both OIL and WATER

NEW JOHN CRANE PLASTIC LEAD SEAL FOR Heavy duty Insoluble

One "easy-spread" application and your sealing job is done—for sure, for years! John Crane new lead seal is plastic: will not set or seize nor harden under temperature extremes. Joints may be broken after years of service and remade without scraping. Protects threads, eliminates corrosion. Prevents scoring and galling. Adjusts to all clearances. May be applied to cork, paper, asbestos, copper, aluminum, lead, steel . . . John Crane Insoluble Plastic Lead Seal is a scientific laboratory formula made from pulverized metallic lead carried in a special vehicle: smooth, easy-spreading, fast-flowing. It is chemically pure: no red lead, clay filler or dope. An insoluble lubricant as well as a seal . . . Send for prices, sample and literature. Packed in 1, 3 and 5 pounds ready for use.

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Temperatures to 600° F. . . . Pressures to 4000 pounds per sq. in.

SERVICES: Oil, gasoline, kerosene, benzol, propane, butane, bottled gases, steam, water, hydrocarbons, aqueous solutions, ammonia, CO_2, toxic and inflammable gases, lutings in plugs.

EQUIPMENT: Threaded joints, flanges and gaskets, nuts, caps, valves, plug valve stems and seats, safety fuse plugs, screwed fittings, pumps, cylinder heads, boilers, compressors, stills, tanks, towers, gas stoves, etc., etc.

Extensively used by ✪ LEADING AIRPLANE BUILDERS

Here are a few simple hints that may help you increase your crane output:

1. Be sure footing is good. A little extra time spent preparing good footing will be more than repaid by increased speed, steadiness and safety of operation. Remember not to let the side of the machine toward the load be low.
2. Do not exceed stability ratings; do not operate with boom angle greater than 78° to horizontal.
3. Accurate control means speed. Keep brakes and clutches in proper adjustment.
4. Use sufficient parts of line to insure needed accuracy of control, combined with minimum stress on the machine.
5. Do not propel machine while boom is at high angle.
6. If you have to move with a load in soft going, the cats will "climb" better if you move with the load behind. Don't travel with close-to-maximum loads.
7. If you move with a load, it should be snubbed to the machine to prevent it from swaying.
8. Set up a regular schedule for inspection and lubrication.

Bucyrus-Erie employees have accepted the award of the Army-Navy "E" as a challenge to keep production rising. ★ ★

Bucyrus-Erie

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REVEALING THE INSIDE STORY ON A COMPRESSOR AND ENGINE OIL-SAVER

IF responsibility for the successful operation of oil wiper rings is divided between you (the engine or compressor builder) and a ring manufacturer, you'll be interested in France oil wiper glands.

France oil wiper glands and rings end this division of responsibility and eliminate custom-made stuffing boxes and their troubles.

The France Oil Wiper Gland completely replaces the oil wiper stuffing box. It provides in one unit a correctly engineered box for the wiper ring with ample space for oil to flow away, and large holes that drain directly downward. It bolts to the splash-head on the *crankcase* side, ending the need for a gasket. The savings in cost on the simplified splash-head alone more than pay for the gland. All you have to do is recess the splash-head, and drill and thread two holes for cap screws.

France supplies standardized oil wiper glands in a wide range of sizes for all engines and compressors. Standardization lowers cost and speeds delivery.

On steam engines and wet gas compressors another oil wiper gland can be placed on the opposite side of the splash-head to wipe condensate from the rod.

Low cost, readily-replaceable France oil wiper rings are supplied in a variety of sizes designed for France oil wiper glands. Success of these rings is due to the ingenious design of the rod-bearing surface. Area of contact is small to intensify pressure on the scraper edge. A groove (see inset) divides the force of the retaining-spring so that the base cannot rock and lift the scraper edge.

Why suffer along with traditional designs when you have such a simple, inexpensive solution of wiper ring problems at hand, and France's long experience to help you? Write for specific information.

★ FRANCE PACKINGS and PISTON RINGS ★

FRANCE MANUFACTURING COMPANY

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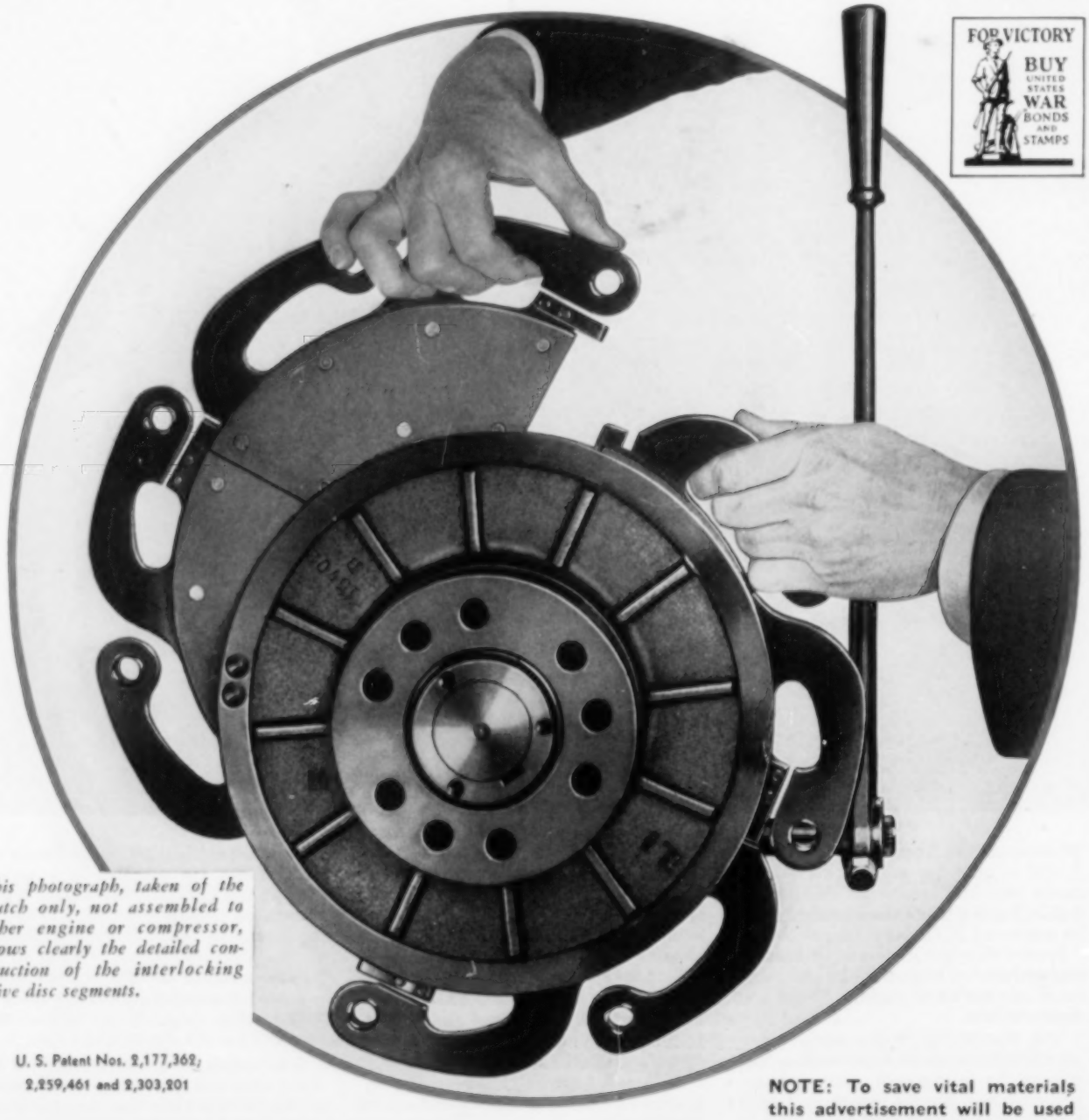
FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.



FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

U. S. Patent Nos. 2,177,362; 2,259,461 and 2,303,201

NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

KEEP A STRAIGHT FACE

Keep your quarry floors level...speed up the loading cycle of your shovels; increase your quarry production by removing the toe. This can be done quickly and economically with the Ingersoll-Rand FM-2 Wagon Drill.

The flexibility of this lightweight, 3-wheel mounting permits its use on all kinds of terrain. Holes can be drilled quickly at any angle—wherever you want them.

Long drill steels can be handled easily. Set-up time is reduced and the time spent in changing steels can be cut in half; hence more footage is drilled in a shift.

The X-71WD Drill used on the FM-2 has been developed especially for wagon drill service. Here's a machine that will withstand a terrific amount of punishment. Its piston has a long stroke and hits a heavy hammer blow—a blow which has unique follow-through characteristics that are so essential for deep-hole drilling. In addition, the drill has powerful rotation and will blow deep holes easily.

The combination of FM-2 flexibility and X-71WD drilling power will help you increase your quarry production. Try Jackbits too. They will speed up your drilling still more.

KEEP 'EM DRILLING

Ask your supplier for an oil that meets I-R Specification 433—the new rock drill lubricant developed by Ingersoll-Rand.

WITH JACKBITS

Ingersoll-Rand

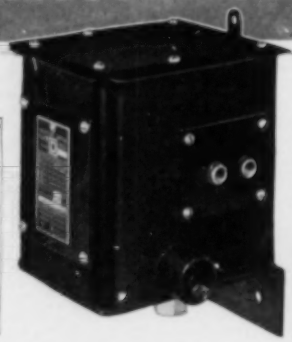
11 BROADWAY, NEW YORK 4, N. Y.

5-368

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

Marine PRESSURE SWITCHES

DRIPPROOF AND WATERTIGHT HIGH SHOCK CONTACT BLOCK—TWO OR THREE POLE—CLASS 9013 TYPE AW-H, MW-H, LW-H



ELECTRICAL RATINGS

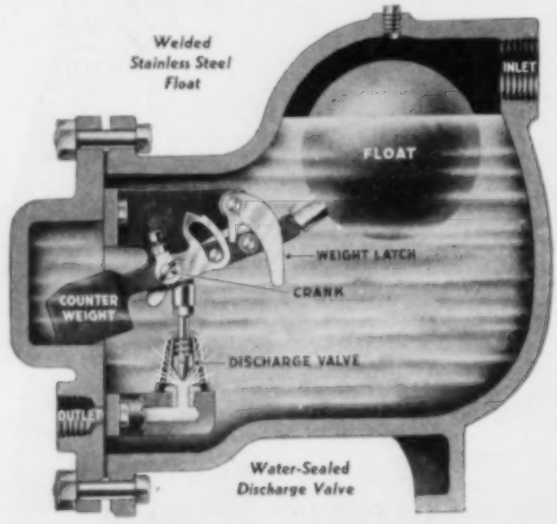
Voltage	Single Phase A.C.	Polyphase A.C.	D.C.
110V.	2 H.P.	3 H.P.	1 H.P.
220V.	3 H.P.	5 H.P.	1 H.P.
440-550	5 H.P.	5 H.P.	.....
32V.	.....	.....	½ H.P.

● Built for Marine Service to conform with requirements for dripproof and watertight devices of shockproof construction. The switches differ from standard in the use of a special sheet steel enclosure and drip hood with gasket seal and a special high shock bakelite contact block in two or three pole form. The three types AW-H, MW-H and LW-H represent three diaphragm sizes and three range and differential variations. A release valve for air compressor service may be added to any of the types, as illustrated. Write for Bulletin 562.

REGULATOR DIVISION

SQUARE D COMPANY

DETROIT • MICHIGAN



NICHOLSON MODEL "JR" Super Traps

FOR AUTOMATICALLY DRAINING AIR TANKS SEPARATORS, RECEIVERS, AFTER-COOLERS, ETC.

Specially designed and constructed to provide long, trouble-free service. Large capacity. Pressures to 200 lbs. Intermittent discharge. Bulletin No. 341.

W. H. NICHOLSON & CO.

180 OREGON ST., WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

COOLANT PUMPS

Sidewall type for capacities to 50 gpm and heads to 20 ft.

Immersion type for capacities to 150 gpm and heads to 125 ft.

Horizontal type for capacities to 60 gpm and heads to 25 ft.

Ingersoll-Rand centrifugal coolant pumps are reliable and trouble-free in operation. There is a size to meet any pumping requirement. A wide variety of liquid can be pumped even though it contains grit and dirt. Ask the Ingersoll-Rand Engineer for complete details.

Ingersoll-Rand

CAMERON PUMP DIVISION

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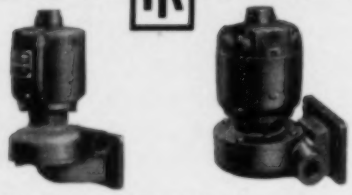
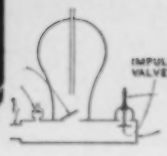
9-252



Sidewall type for capacities to 60 gpm and heads to 25 ft. (Left) standard unit, (Right) low-submergence unit.



PUMPS-HYDRAULICS-AIR COMPRESSORS

JUST OUT! 3 BOOKS IN ONE—OVER 1650 PAGES, 1654 ILLUSTRATIONS, WITH QUESTIONS AND ANSWERS. COMPLETE PRACTICAL CONCISE INFORMATION FOR ALL ENGINEERS AND OPERATORS.

***PART 1*—PUMPS—850 Pages:** All types—Centrifugal—Rotary—Reciprocating Pumps: Their Theory, Construction, Operation and Calculations. Air and Vacuum Chambers—Power Pumps—Air Pumps—Jet Condensers—Surface Condensers—Condenser Auxiliaries—Condenser Operation—Calculations—Cooling Ponds—Cooling Towers—Water Supply—Hydraulic Rams—Special Service Pumps—Automotive Fire Pumps—Dredges—Codes. 942 Illustrations.

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Send postpaid AUDELS PUMPS, HYDRAULICS, AIR COMPRESSORS ($4). If I decide to keep it, I will send you $1 within 7 days; then remit $1 monthly until purchase price of $4 is paid. Otherwise, I will return it promptly.

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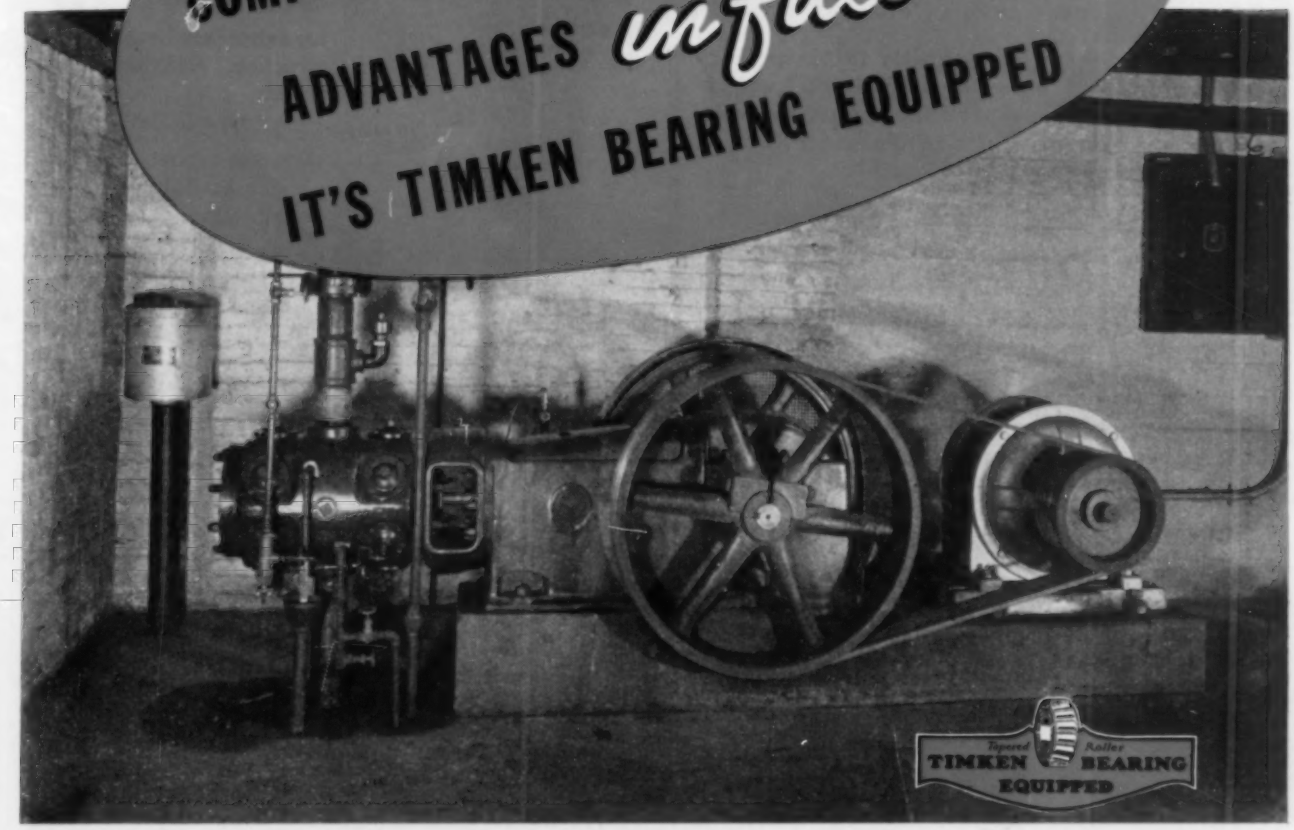
Occupation.....

Employed by..... C.A.M.

THIS INGERSOLL-RAND COMPRESSOR EMBODIES ANTI-FRICTION ADVANTAGES *in full* — IT'S TIMKEN BEARING EQUIPPED



Ingersoll-Rand 9 x 9 Class ES Compressor equipped with Timken Bearings on the crank shaft, installed in a manufacturing plant. This unit operates at 325 RPM and delivers 153 cu. ft. of air at 100 lbs. pressure. It is operated by a 30 H.P. 400 volt induction motor.

If you are thinking of buying an anti-frictionized compressor of any type—portable or stationary; air or gas—you might as well have every advantage that anti-frictionization can give. You'll get them all if the compressor is equipped with Timken Tapered Roller Bearings—for Timken Bearings possess every necessary quality. They eliminate friction; carry radial, thrust and combined loads; and hold moving parts in constant alignment.

These Timken Bearing qualities mean smoother operation; reduced wear; lower operating and maintenance costs; greater endurance; and longer equipment life. Make sure you have them in your new compressors. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

One Thing

THE WAR WON'T CHANGE

When the war, Limitation Orders are rescinded after and KOH-I-NOOR Drawing PENCILS become available to everyone, there won't be any new designs or new models.

Pencil users will be chiefly interested in the life of a pencil—its uniform quality —its ability to produce clear, smooth and sharply defined lines.

KOH-I-NOOR will continue as it has done for more than 50 years, to deliver the same fundamental quality that has made it one of the best Drawing Pencils that money can buy.

KOH-I-NOOR Drawing PENCILS are available in 17 degrees of uniform hardness — smartly packaged — one dozen to the container.

NO. 930 AVIATOR COLORED PENCILS — A complete range of smooth working colors. Ideal for rendering, photo coloring, map work, etc. At your dealer in single colors or sets of 12 or 24 assorted colors.

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KOH-I-NOOR PENCIL COMPANY, INC.

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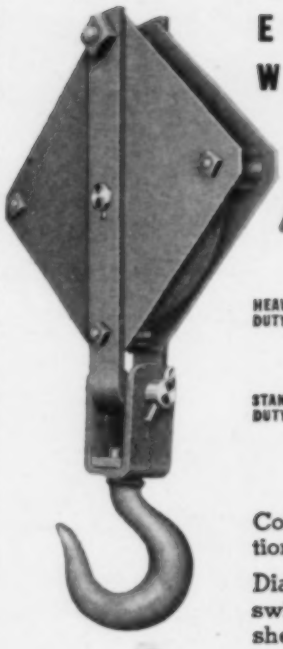

EXPERIENCED WIRE ROPE USERS *prefer* AMERICAN Wire Rope Blocks

HEAVY DUTY — for extremely heavy construction and erection work.

STANDARD DUTY — for average work, which includes most of the service in industry and construction.

Correct design, rugged construction.

Diamond shell with plain hook, swivel hook or shackle: Oval shell snatch blocks with swivel hooks.

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1883 - 1943

AMERICAN TERRY DERRICK CO.
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FOR SAFETY

Save AIR, TIME, EFFORT!

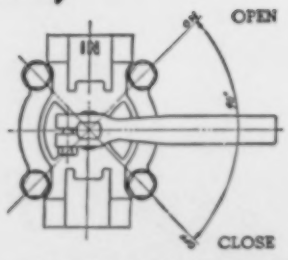
with NOPAK Quick-Opening SHUT-OFF VALVES

Finger-Touch

A flick of the finger opens or closes the NOPAK Shut-Off Valve. There's no slow, laborious wheel-turning . . . no pressure lost while valve is manipulated . . . no working time lost!

On lines connected to air guns, chipping hammers, drills and other air powered tools, these quick-acting valves prevent air waste, conserve valuable man hours for production effort.

The patented NOPAK Rotating Disc principle makes these shut-off valves leakproof and wearproof. Their flat, lapped-disc sealing surfaces improve with use. There are no tapered plugs or interlocking contours to stick or wear out . . . no packing to replace. Pressure sealed disc and seat are always protected from grit abrasion. May also be used for Oil, Water or Gas.



Quarter-Turn Lever Control

A quarter-turn of the valve lever positively opens or closes the valve, permits quick or throttling action. Position of lever shows degree of opening.

Write for Illustrated Folder

GALLAND-HENNING MFG. CO., 2759 S. 31st St., Milwaukee 7, Wis.

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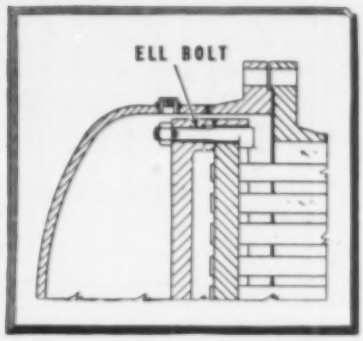
NOPAK VALVES and CYLINDERS

DESIGNED for AIR or HYDRAULIC SERVICE

A 4104-½H-A

ELL BOLT
CONSTRUCTION
a feature of the Patented
VOGT HEAT EXCHANGER
Floating Tube Sheet Assembly



Patent Nos.
1,895,735
2,232,478

Assures NO LEAKS HERE

YOU LOSE when an exchanger leaks . . . . with the possibility of fluid contamination, or shut down for repairs.

None of these evils need plague you when you employ the Vogt patented floating tube sheet assembly because there is no distortion of a split ring to worry about in making up the joint time after time. Its easy to make tight and it stays tight!

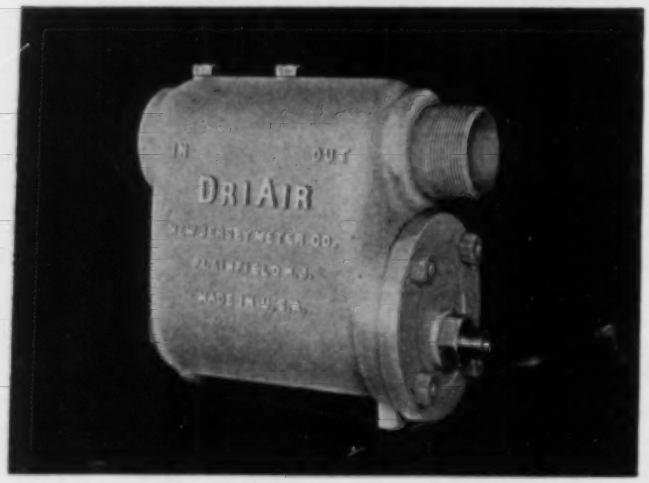
Critical materials are saved too because the design makes possible a smaller diameter of shell through reduction of the dead space between the shell and the tube bundle.

Our new bulletin HE-5 is a pictorial presentation of standard and special types of Vogt Heat Exchangers. Write for a copy on your letter head.

HENRY VOGT MACHINE COMPANY
Incorporated
LOUISVILLE 10, KENTUCKY
Branch Offices: New York, Philadelphia, Cleveland, Chicago, Dallas.

Vogt *Heat Transfer* EQUIPMENT

DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

● The answer to many problems which arise in various applications of compressed air, DriAir speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request; write today.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

In Steel Mills Clean, Dry Air is a "Must"!

This Aridifier removes dirt, moisture and oil from the air line in this large Eastern steel plant—one of many steel mill users. Air-operated skip hoists, controls and other equipment are fully protected from the destructive effects of contamination in compressed air.

The Aridifier is always effective because it employs the one correct principle for removing air contamination—centrifugal force.

The Aridifier in this steel plant is the flanged type, used in air lines from 3" to 10". The threaded type, shown below, is standard for smaller sizes; ⅜" to 2". Send for Bulletin 543.

LOGAN ENGINEERING CO.
4911 Lawrence Ave., Chicago, Ill.

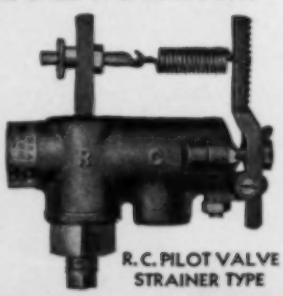
Engineering Representatives in Principal Cities

The ARIDIFIER

Dries and Cleans Compressed Air

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



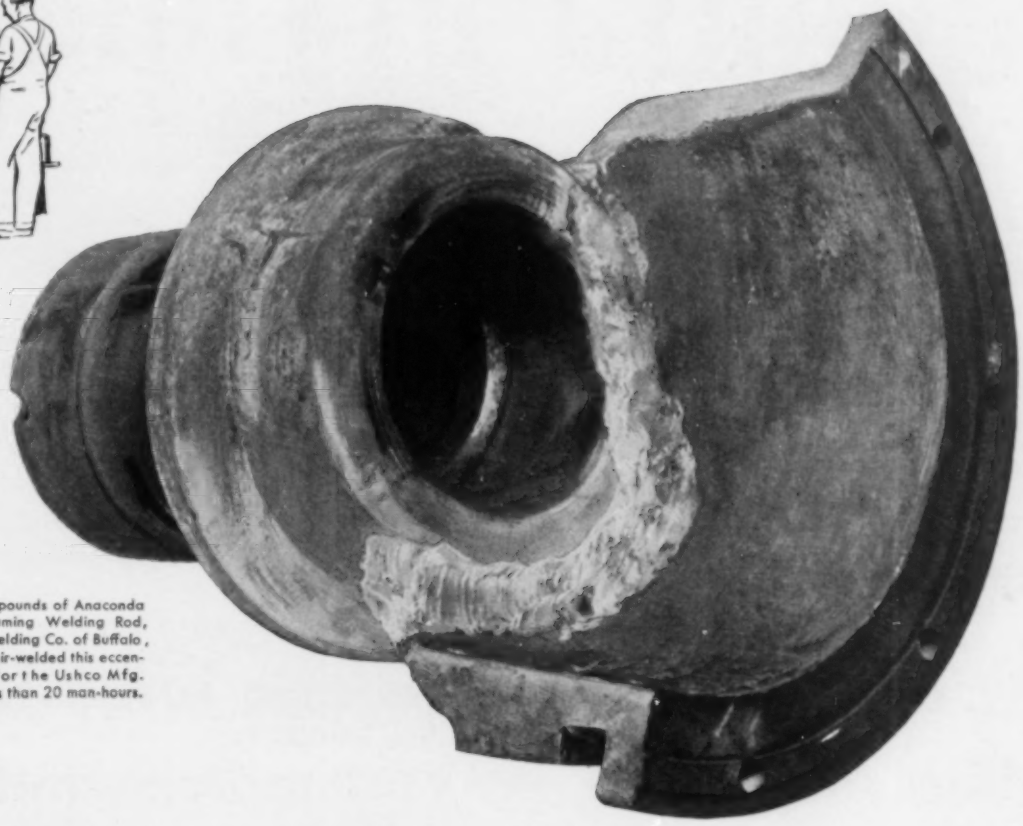
R. C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.

1207 FRENCH STREET · ERIE, PA.

PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

Short, short story



Using only 18 pounds of Anaconda "997" Low Fuming Welding Rod, the Hebeler Welding Co. of Buffalo, New York, repair-welded this eccentric housing for the Ushco Mfg. Co., Inc., in less than 20 man-hours.

Important war production plant...
Eccentric housing breaks on drop forge hammer...
Welded with Anaconda "997" Low Fuming...
Hammer back on job next day!

That's the way low-temperature Bronze welding is helping out in emergencies these busy days. A broken 2½-ton gear was returned to service in less than a week; a seven-foot fracture in a 6-ton press column was repaired in three days; a fractured 2-ton section of a 100" boring mill was repair-welded in 39 hours.

And so it goes—in every branch of industry, on every type of equipment—on parts made of cast iron, steel, malleable iron and copper alloys.

Keep in mind this modern method of salvaging costly machine tools, production parts and equipment—at a fraction of the cost of new replacement parts. Keep in mind also that Tobin Bronze*, "997" Low Fuming and other Anaconda Welding Rods are preferred by many industrial shops for making dense, high strength, Bronze welding repairs.

*Reg. U. S. Pat. Off. 4878

THE AMERICAN BRASS COMPANY
General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

ANACONDA *Anaconda Welding Rods*

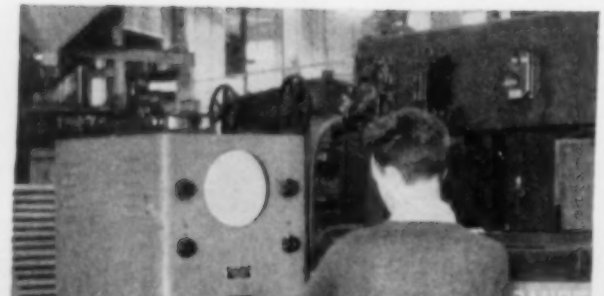
SHORTS STYMIED

Voltage surges which accompany switching and frequent starting and stopping of motors impose high dielectric stresses on the coil insulation, and can cause harmful short circuits. Yet this is an unavoidable condition of service for many motors.

The grinder shown here, for example, starts and stops every time a finished part is removed and a new part inserted. But the two Tri-Clad motors that drive it have been built to withstand safely the voltage surges ordinarily encountered in this type of service. Their ability to "stymie" shorts was proved by *the new General Electric test* described below.

External grinder, equipped with two Tri-Clad motors, installed in the milk-machinery manufacturing plant of the Rite-Way Products Company, Chicago, Ill.

New high-potential, electronic surge-tester verifies strength of TRI CLAD motor windings



This electronic test of insulation makes a "cardiogram" of every Tri-Clad motor winding, ferreting out weaknesses that might lead to shorts caused by voltage surges in service. It tests each turn, coil, and phase group of the windings for adequate insulation strength to withstand the "steep front" high-voltage surges of actual service. First developed and applied by G.E., it's one of the production tests which all Tri-Clad motors must pass as they come off our production lines. – *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

TRI CLAD MOTORS

Each week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

a drop in the bucket

A drop in the bucket, infinitesimal compared with the torrent that pours over Niagara Falls, is nevertheless significant—as significant as a single bullet in a total war. Both drop and bullet are symbols of mighty forces in the irresistible tidal wave of victory.

In the obscure background of this all-out war—unheralded and unsung—liquids are the key to ultimate success. Without them, wheels would not turn, machinery could not operate, ships could not sail, airplanes could not leave the ground—man could not exist.

Through forests and desert wastes, in steel mills and factories, in mines and on ships, in refineries and on the farm, liquids are on the move—liquids for cooling, for processing, for cleaning, for refrigeration—oil for fuel—oil for lubrication—milk, syrup, soups—gasoline—acids—chemicals—alcohol—pulps—liquids for war and for the well-being and comfort of man.

To meet myriad and diversified needs, countless gallons are on the move and centrifugal pumps are supplying the impetus—Ingersoll-Rand Pumps of many sizes and types—built to resist corrosion, to obviate severe shock, to meet new demands in pressures and temperatures, to solve countless problems in numberless applications.

Ingersoll-Rand

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CENTRIFUGAL PUMPS • CONDENSERS • COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES

SAFEGUARDING THE HELICOPTER'S HEART

One feature that has played an important part in the success of the Sikorsky helicopter is the development of "cyclic pitch control."

The mechanism that operates this control passes through the main rotor hub.

It is the heart of the helicopter.

And you will find this heart fastened safely and securely with Elastic Stop Nuts.

These are the nuts with the red elastic collar—the nuts which have revolutionized aircraft construction.

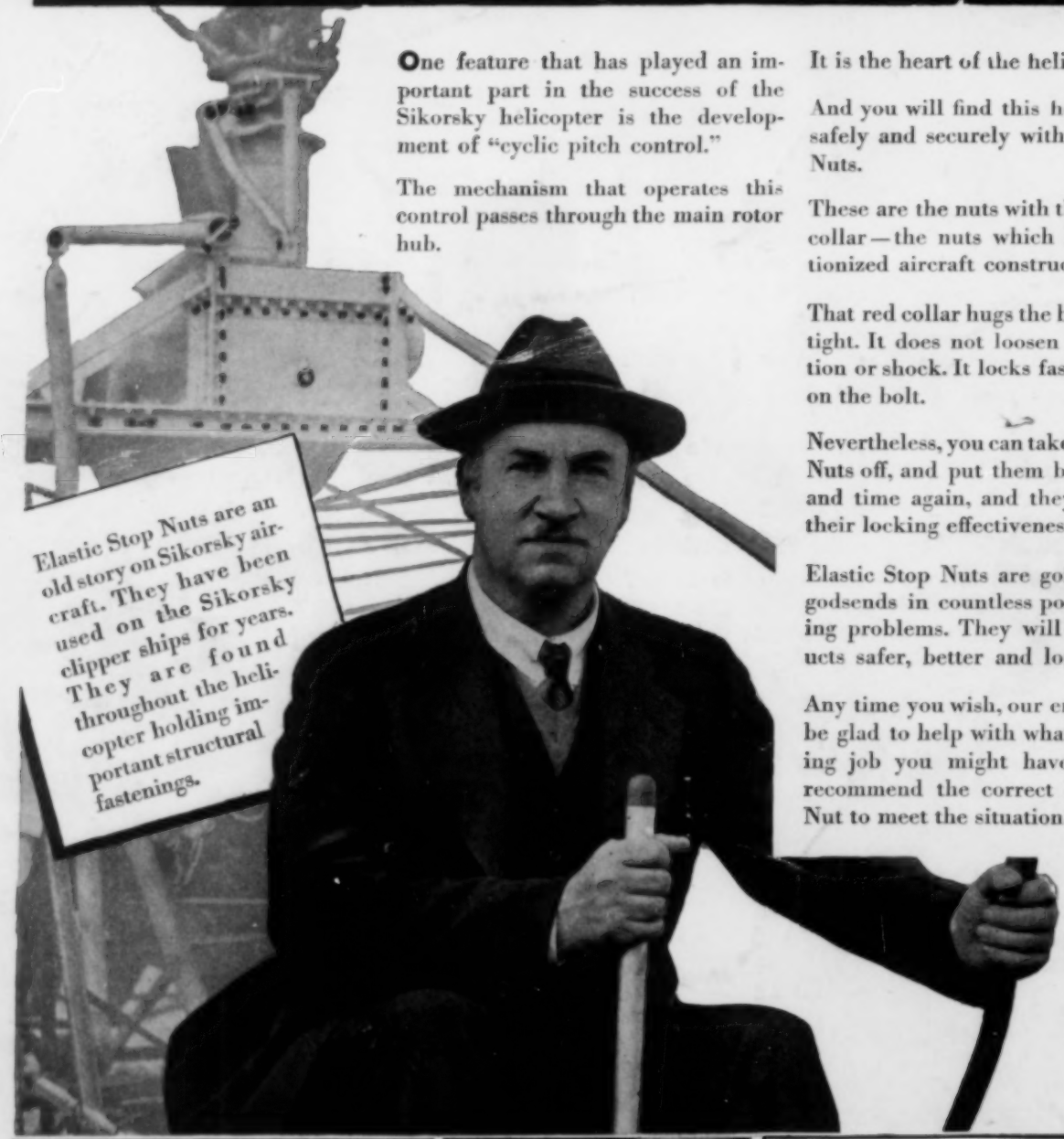
That red collar hugs the bolt and grips tight. It does not loosen under vibration or shock. It locks fast—anywhere on the bolt.

Nevertheless, you can take Elastic Stop Nuts off, and put them back on, time and time again, and they still retain their locking effectiveness.

Elastic Stop Nuts are going to prove godsends in countless postwar fastening problems. They will make products safer, better and longer lasting.

Any time you wish, our engineers will be glad to help with whatever fastening job you might have. They will recommend the correct Elastic Stop Nut to meet the situation.

Elastic Stop Nuts are an old story on Sikorsky aircraft. They have been used on the Sikorsky clipper ships for years. They are found throughout the helicopter holding important structural fastenings.



LOCKED ON THE BOLT BY THE ACTION OF THE GRIPPING RED COLLAR.
THE COLLAR IS ELASTIC, THE NUT CAN BE USED TIME AND TIME AGAIN.
MADE IN ALL SIZES AND TYPES—WITH THREADS TO FIT ANY STANDARD TYPES OF BOLTS.

ESNA

TRADE MARK OF

ELASTIC STOP NUT CORPORATION OF AMERICA
UNION, NEW JERSEY AND LINCOLN, NEBRASKA

ELASTIC STOP NUTS

Lock fast to make things last